

TEST REPORT

ACCORDING TO: FCC CFR 47 Part 90, subpart I

FOR:

Mettrycom Communications Ltd.
Wireless IPv6 data acquisition
and control system
Model: MS3000-MT-450
FCC ID:2AG7UMS3000-450

This report is in conformity with ISO/IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested.
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1 Applicant information

Client name: Metrycom Communications Ltd.
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Telephone: +972 9779 2050
Fax: +972 9779 2065
E-mail: shay@metrycom.com
Contact name: Mr. Shay Frenkel

2 Equipment under test attributes

Product name: Wireless IPv6 data acquisition and control system
Product type: Transceiver
Brand name: MetrySense-3000
Model(s): MS3000-MT-450
Hardware version: MS3000-MT-450, version D
Software release: 4.0.0
Receipt date 04-Jan-16

3 Manufacturer information

Manufacturer name: Metrycom Communications Ltd.
Address: 20 Galgalei Haplada street, Herzliya 4673324, Israel
Telephone: +972 9779 2050
Fax: +972 9779 2065
E-Mail: shay@metrycom.com
Contact name: Mr. Shay Frenkel

4 Test details




Project ID: 27772
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 04-Jan-16
Test completed: 14-Jan-16
Test specification(s): FCC CFR 47 Part 90, subpart I

5 Tests summary

Test	Status
Transmitter characteristics	
Section 90.205, Maximum output power	Pass
Section 90.209, Occupied bandwidth	Pass
Section 90.210, Emission mask	Pass
Section 90.210, Radiated spurious emissions	Pass
Section 90.210, Conducted spurious emissions	Pass
Section 90.213, Frequency stability	Pass
Section 90.214, Transient frequency behaviour	Pass
Section 2.1091, RF radiation exposure evaluation	Pass, Exhibit in application for certification provided

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.

The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer	January 14, 2016	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	January 31, 2016	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	March 2, 2016	

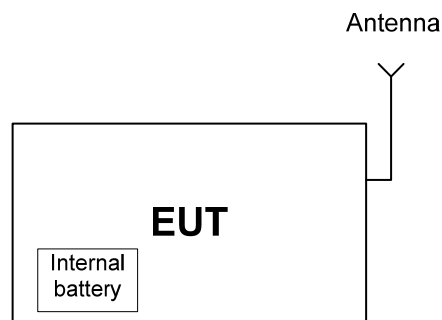
6 EUT description

6.1 General information

The EUT, model name MS3000-MT-450, is a modular low-power outdoor connectivity system that interfaces digital and analog sensors, meters and actuators and connects them via a low power wireless mesh-network to IP gateways and remote monitoring centers.

The EUT comprises two radio modules Tx/Rx operating in 450-470 MHz, working in channels 12.5 kHz or 25 kHz.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

6.4 Transmitter characteristics

Type of equipment					
X	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
Intended use		Condition of use			
	fixed	Always at a distance more than 2 m from all people			
X	mobile	Always at a distance more than 20 cm from all people			
	portable	May operate at a distance closer than 20 cm to human body			
Assigned frequency range		450- 470 MHz			
Maximum rated output power		At transmitter 50 Ω RF output connector		25.67 dBm	
Is transmitter output power variable?		No			
		X	Yes	continuous variable	
				stepped variable with stepsize	
				dB	
				minimum RF power	
		maximum RF power		27 dBm	
Antenna connection					
unique coupling	X	standard connector	integral	with temporary RF connector	
				without temporary RF connector	
Antenna/s technical characteristics					
Type	Manufacturer		Model number		Gain
External omnidirectional	Metrycom		NA		2.15 dBi
External omnidirectional	ZDA Communications US LLC.		ZDAQJ450-7		7 dBi
External Yagi	ZDA Communications US LLC.		ZDADJ450-8YG		8 dBi
External omnidirectional	L-Com		HG459U		8.5 dBi
Transmitter 99% power bandwidth		12.5 kHz		25 kHz	
Transmitter aggregate data rate/s		6.7 kbps		11 kbps	
Type of modulation		GFSK			
Modulating test signal (baseband)		PRBS			
Maximum transmitter duty cycle in normal use		Tx ON time		Period	
Transmitter duty cycle supplied for test		Tx ON time		Period	
Transmitter power source					
X	Battery	Nominal rated voltage	3.3 VDC	Battery type	Energizer L91 AA size
X	DC	Nominal rated voltage	12 VDC		
	AC mains	Nominal rated voltage	VAC	Frequency	Hz
Common power source for transmitter and receiver		X		yes	no

Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

7 Transmitter tests according to 47CFR part 15 subpart C requirements

7.1 Peak output power test for 12.5 kHz CBW

7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum output power (ERP)	
	W	dBm
450.0 –470.0	0.5	27

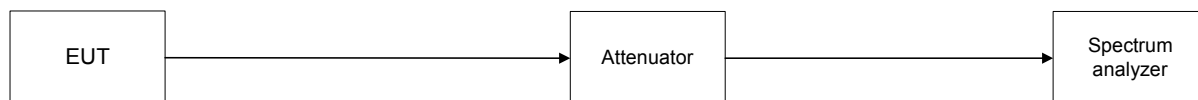
7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and the associated plots.

Figure 7.1.1 Peak output power test setup





Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE: 450 – 470 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 30 kHz
 VIDEO BANDWIDTH: 100 kHz
 MODULATION: GFSK
 BIT RATE: 6.7 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
450	25.67	included	included	25.67	27	-1.33	Pass
460	25.45	included	included	25.45	27	-1.55	Pass
470	25.24	included	included	25.24	27	-1.76	Pass

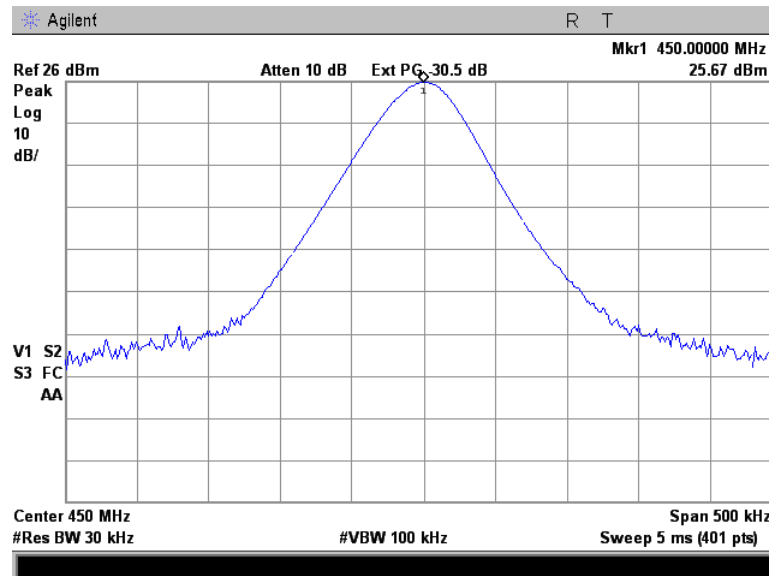
Reference numbers of test equipment used

HL 3440	HL 3455	HL 3818	HL 3903				
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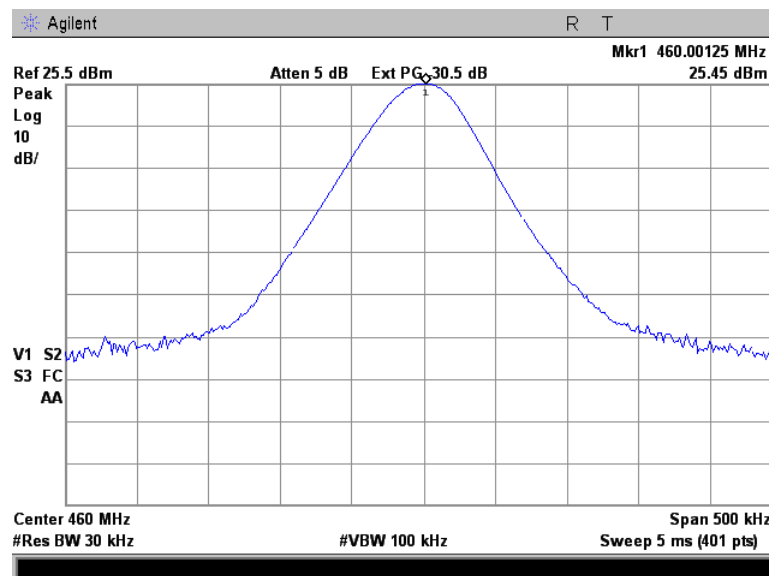
Full description is given in Appendix A.

Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.1.1 Peak output power test results at low frequency



Plot 7.1.2 Peak output power test results at mid frequency

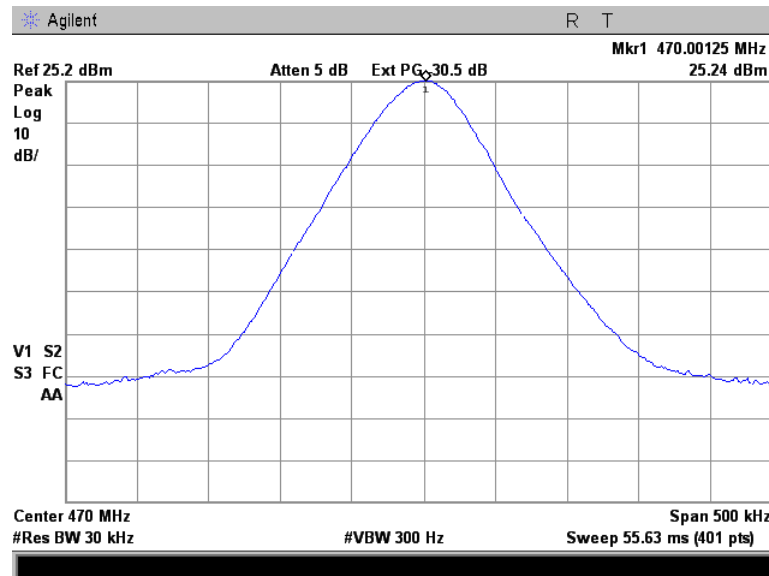




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Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.1.3 Peak output power test results at high frequency





Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

7.2 Peak output power test for 25 kHz CBW

7.2.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power (ERP)	
	W	dBm
450.0 –47.0	0.5	27

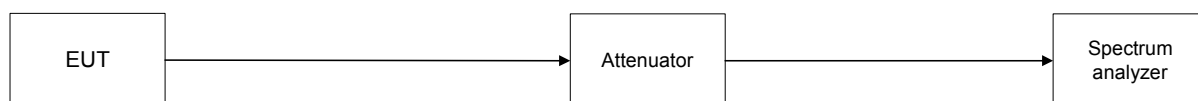
7.2.2 Test procedure

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.2.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Peak output power test setup





Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Table 7.2.2 Peak output power test results

OPERATING FREQUENCY RANGE: 450 – 470 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 30 kHz
 VIDEO BANDWIDTH: 100 kHz
 MODULATION: GFSK
 BIT RATE: 11 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
450	22.23	included	included	22.23	27	-4.77	Pass
460	22.11	included	included	22.11	27	-4.89	Pass
470	21.60	included	included	21.60	27	-5.40	Pass

Reference numbers of test equipment used

HL 3440	HL 3455	HL 3818	HL 3903				
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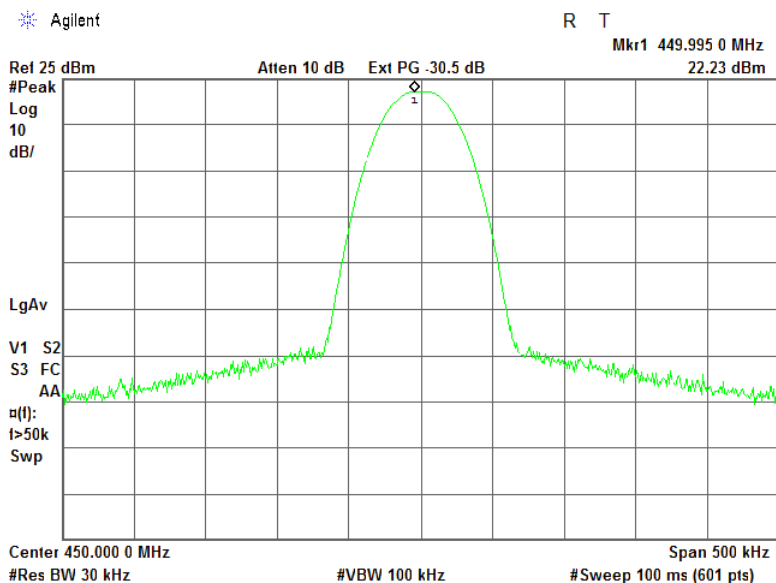
Full description is given in Appendix A.



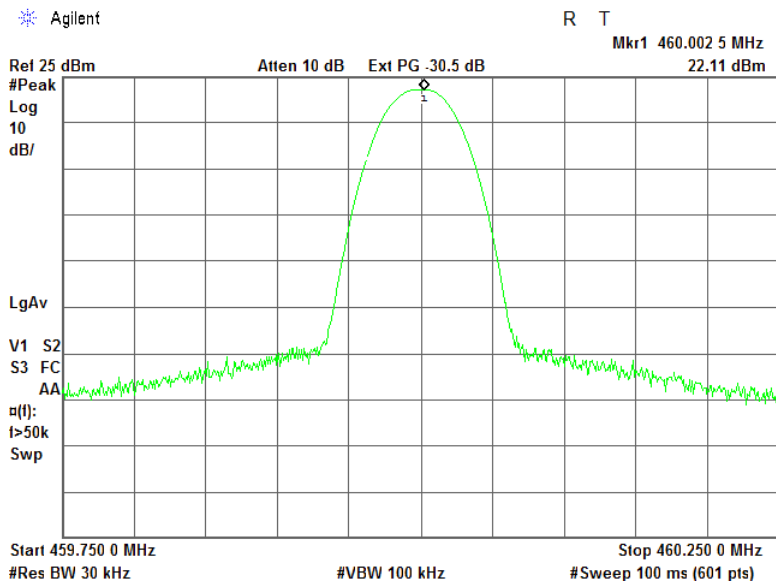
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Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.2.1 Peak output power test results at low frequency



Plot 7.2.2 Peak output power test results at mid frequency

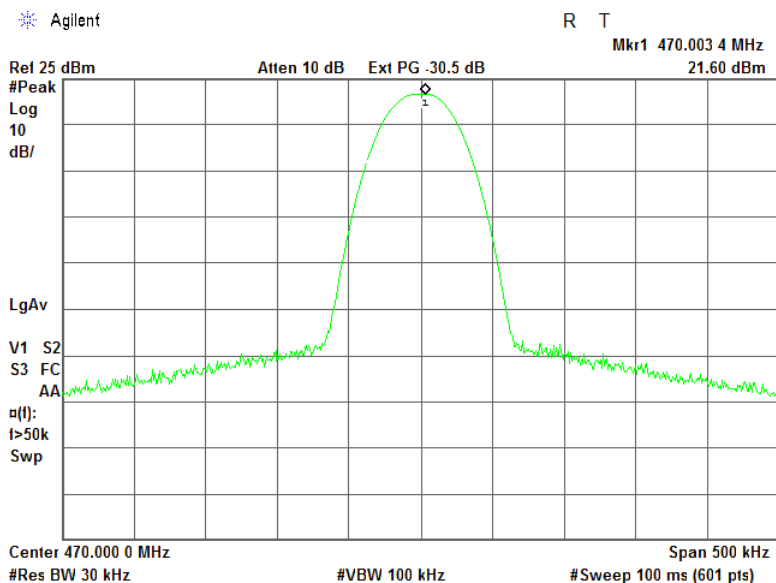




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Test specification:		Section 90.205, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.2.3 Peak output power test results at high frequency



Test specification:		Section 90.209, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

7.3 Occupied bandwidth test for 12.5 kHz CBW

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450-470	26	12.5

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.3.2 Test procedure

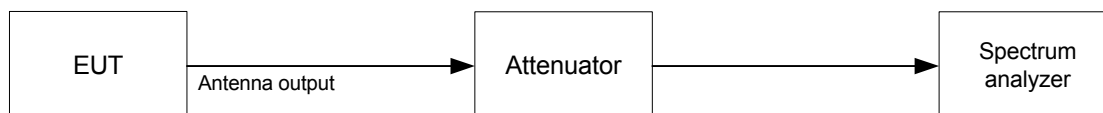
7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.3.2.3 The EUT was set to transmit the normally modulated carrier.

7.3.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.3.2 and the associated plots.

Figure 7.3.1 Occupied bandwidth test setup





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Test specification:		Section 90.209, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 130 Hz
 VIDEO BANDWIDTH: 1.3 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
 MODULATION: GFSK
 BIT RATE: 6.7 kbps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450	11.577	12.5	-0.923	Pass
460	11.969	12.5	-0.531	Pass
470	12.003	12.5	-0.497	Pass

Reference numbers of test equipment used

HL 3433	HL 3818	HL 4968				
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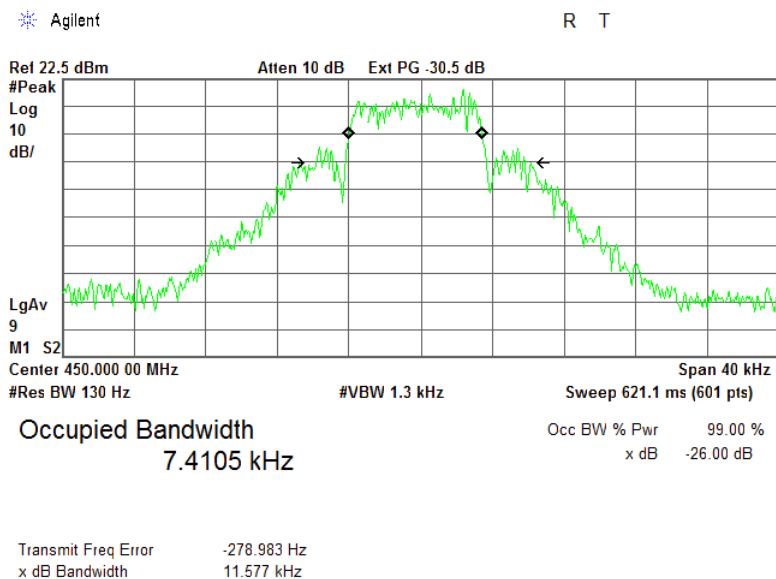
Full description is given in Appendix A.



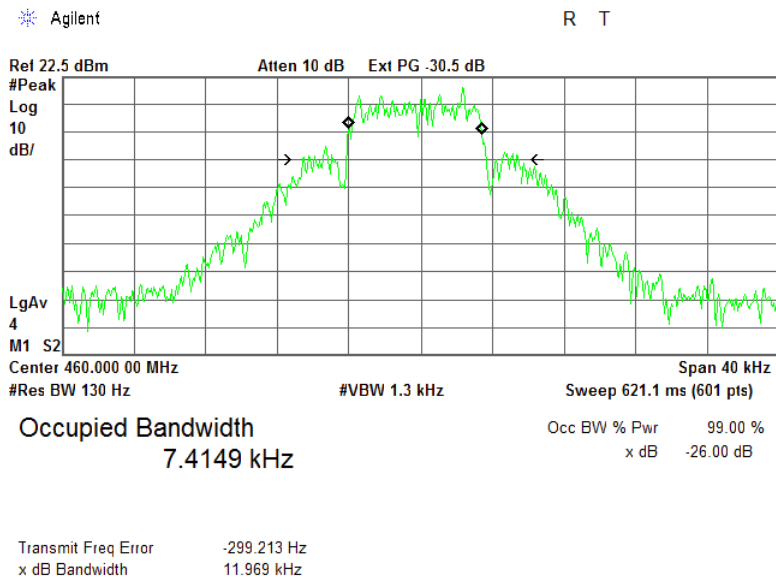
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Test specification: Section 90.209, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance			Verdict: PASS
Date(s): 06-Jan-16			
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.3.1 Occupied bandwidth test result at low frequency



Plot 7.3.2 Occupied bandwidth test result at mid frequency

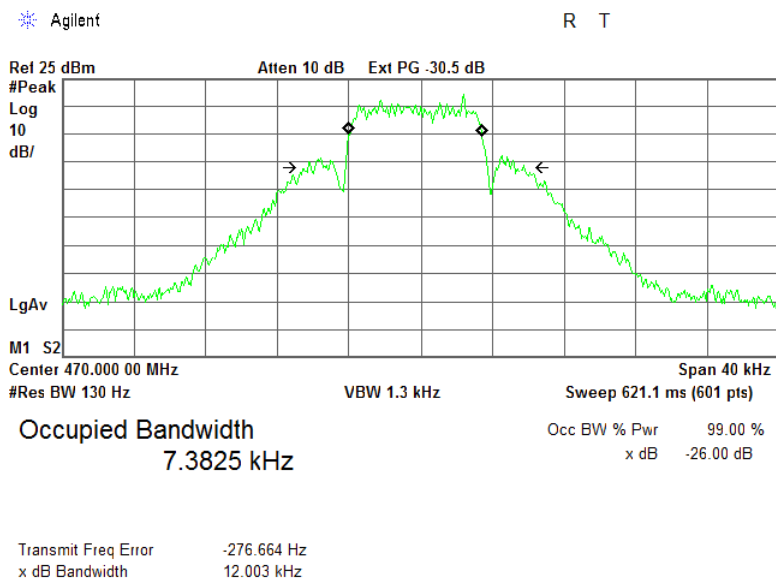




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Test specification:		Section 90.209, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Verdict: PASS	
Date(s):			
06-Jan-16			
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.3.3 Occupied bandwidth test result at high frequency



Test specification:		Section 90.209, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

7.4 Occupied bandwidth test for 25 kHz CBW

7.4.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450-470	26	25

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

7.4.2 Test procedure

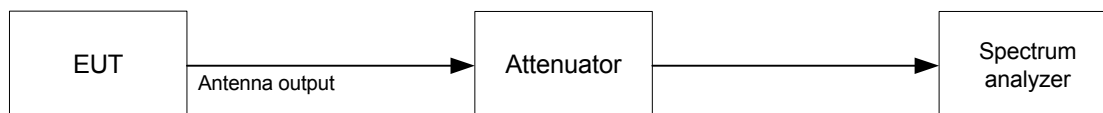
7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

7.4.2.2 The EUT was set to transmit the unmodulated carrier and the reference peak power level was measured.

7.4.2.3 The EUT was set to transmit the normally modulated carrier.

7.4.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.4.2 and the associated plots.

Figure 7.4.1 Occupied bandwidth test setup





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Test specification:		Section 90.209, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Table 7.4.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
 RESOLUTION BANDWIDTH: 300 Hz
 VIDEO BANDWIDTH: 1 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
 MODULATION: G FSK
 BIT RATE: 11 kbps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450	20.315	25	-4.685	Pass
460	20.413	25	-4.587	Pass
470	20.310	25	-4.690	Pass

Reference numbers of test equipment used

HL 3433	HL 3818	HL 4968					
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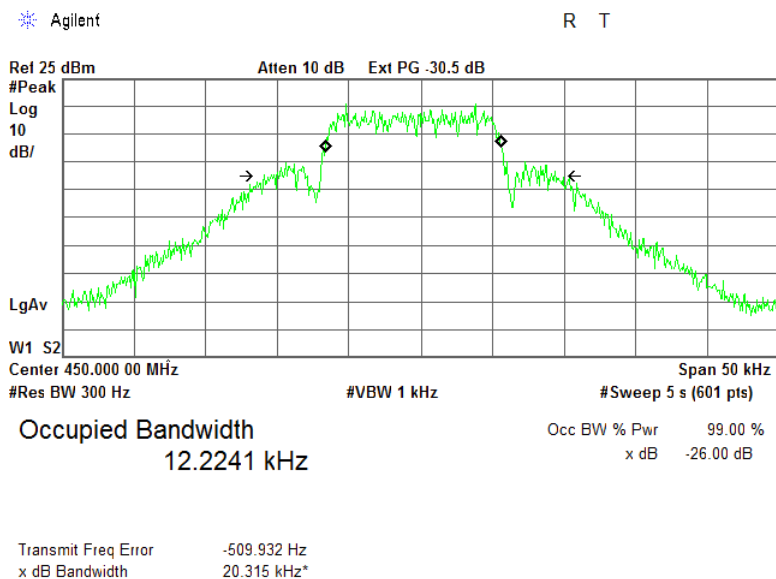
Full description is given in Appendix A.



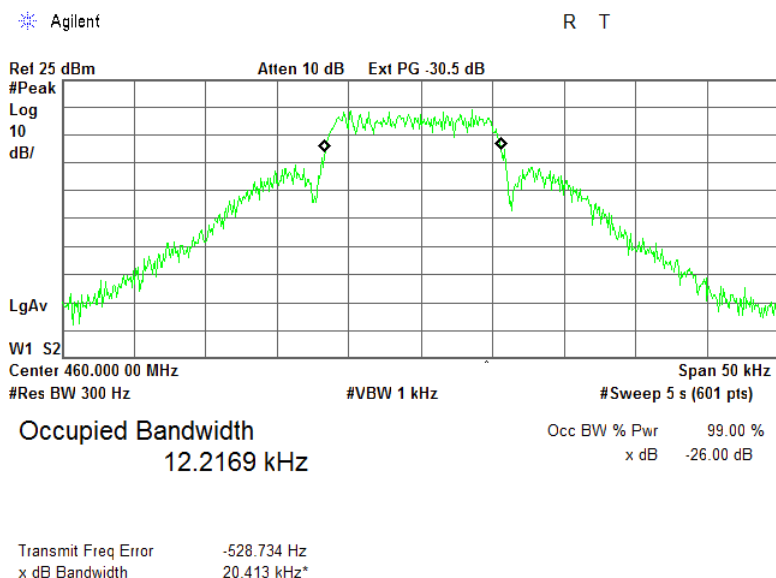
HERMON LABORATORIES

Test specification: Section 90.209, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance			Verdict: PASS
Date(s): 06-Jan-16			
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.4.1 Occupied bandwidth test result at low frequency



Plot 7.4.2 Occupied bandwidth test result at mid frequency

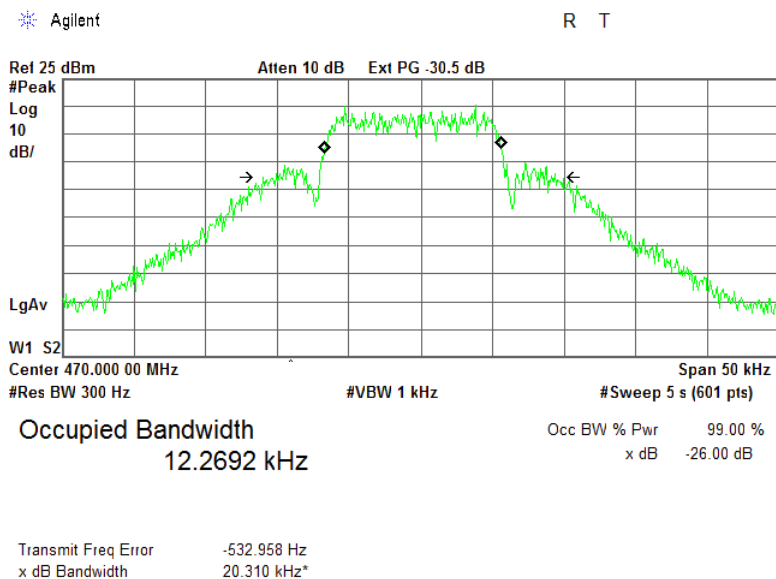




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Test specification: Section 90.209, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance			Verdict: PASS
Date(s): 06-Jan-16			
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.4.3 Occupied bandwidth test result at high frequency



Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

7.5 Emission mask test for 12.5 kHz CBW

7.5.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Emission mask limits

Frequency displacement from carrier	Attenuation below carrier, dBc
Emission mask D (Channel bandwidth 12.5 kHz, authorized bandwidth 12.0 kHz)	
0 – 5.625 kHz	0
5.625 – 12.5 kHz	20 – 70*
More than 12.5 kHz	50+10logP(W)

* - linearly increase with frequency

7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

7.5.2.2 The emission mask was measured with spectrum analyzer as provided in the associated plots. The test results recorded in Table 7.5.2.

Figure 7.5.1 Emission mask test setup





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Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C		Air Pressure: 1020 hPa	Relative Humidity: 56 %
Remarks: CBW 12.5 kHz		Power Supply: Battery	

Table 7.5.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450	Emission mask D	Pass
460		
470		

Reference numbers of test equipment used

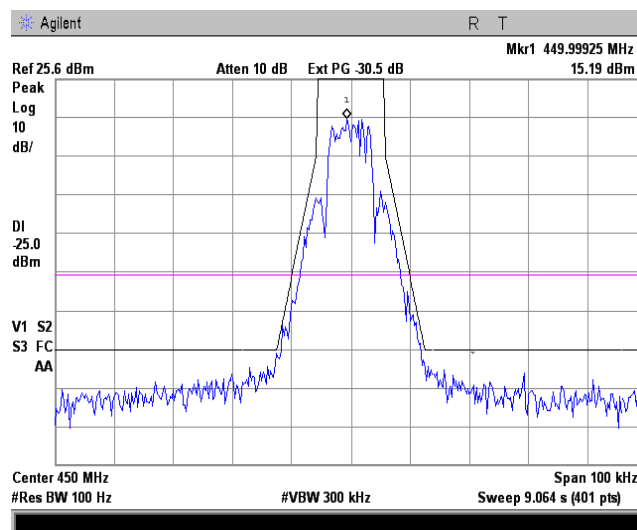
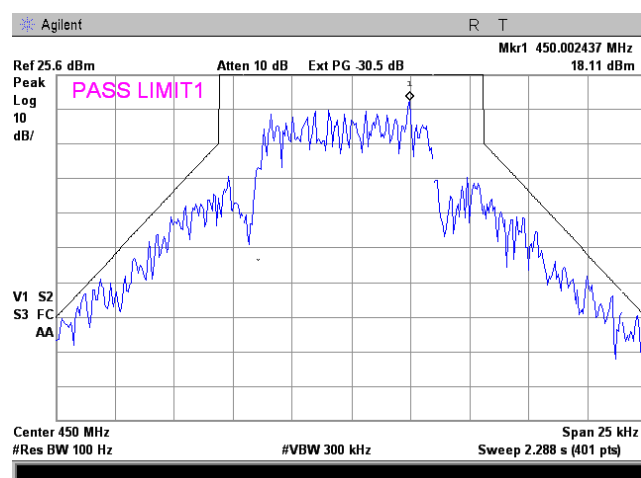
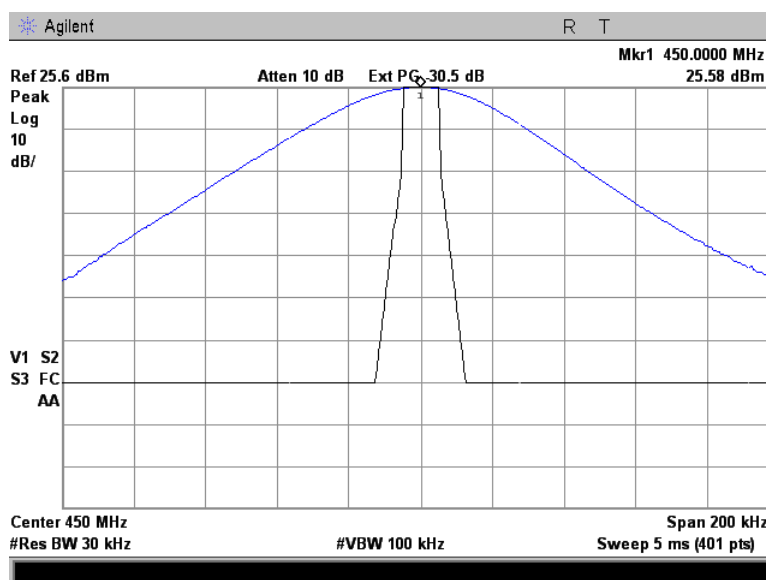
HL 2780	HL 3435	HL 3440	HL 3455	HL 4275
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Full description is given in Appendix A.

Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.5.1 Emission mask test results at low carrier frequency

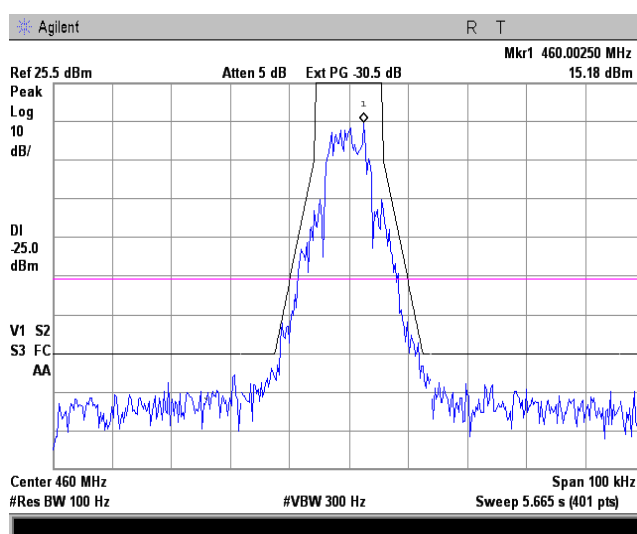
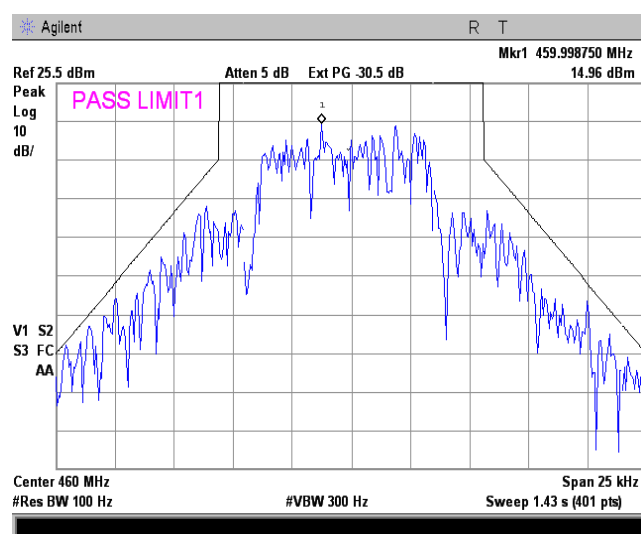
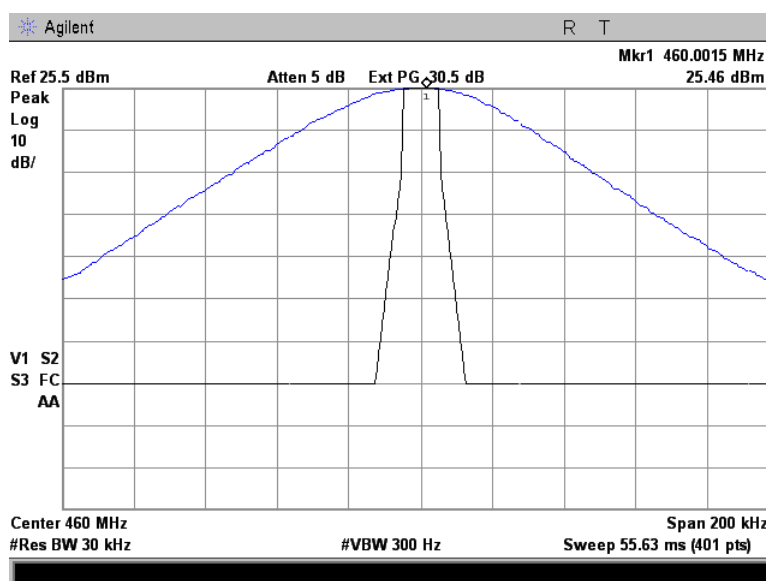
OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: GFSK
BIT RATE: 6.7 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.5.2 Emission mask test results at mid carrier frequency

OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: GFSK
BIT RATE: 6.7 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



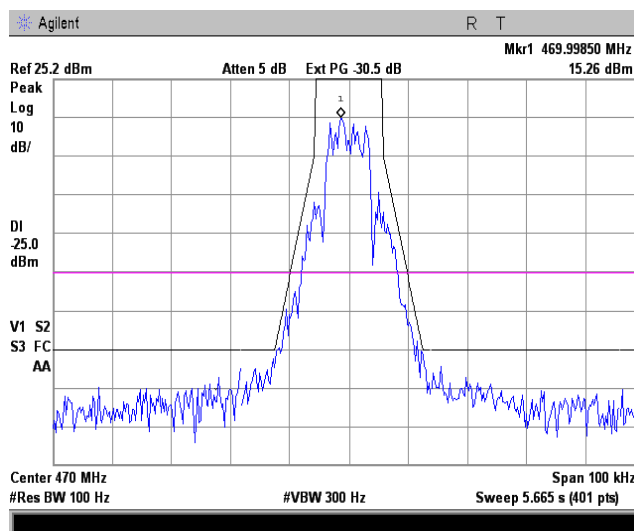
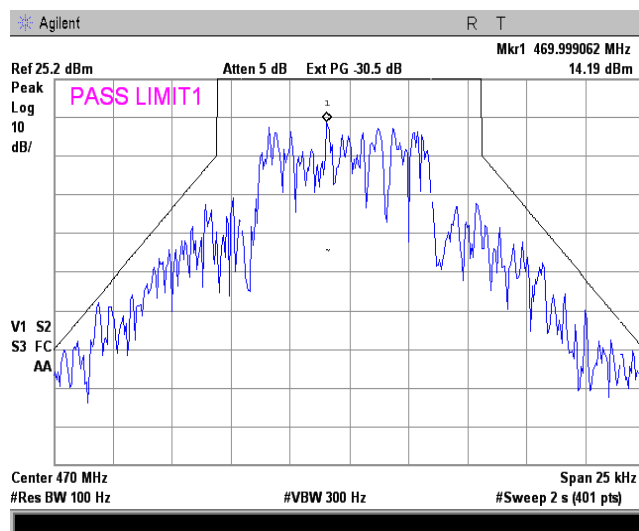
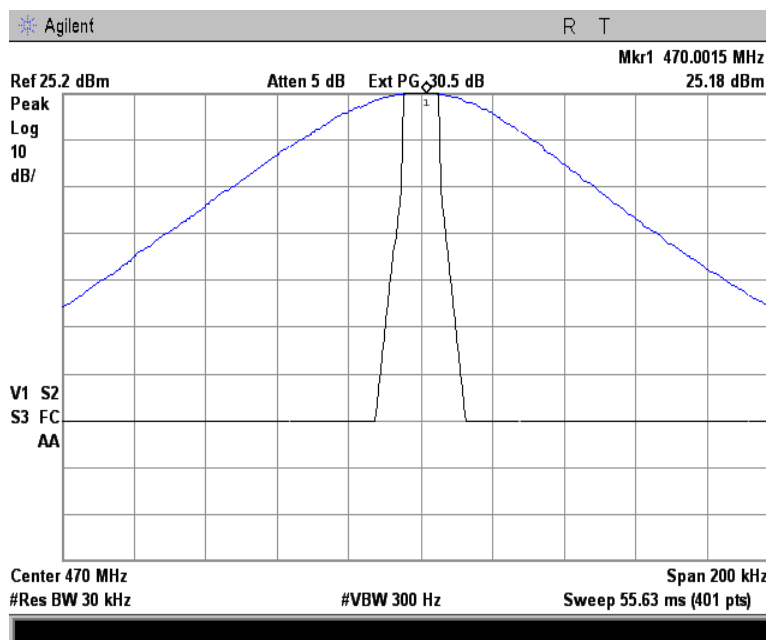


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Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.5.3 Emission mask test results at high carrier frequency

OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: GFSK
MODULATING SIGNAL: PRBS
BIT RATE: 6.7 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16 - 12-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

7.6 Emission mask test for 25 kHz CBW

7.6.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Emission mask limits

Frequency displacement from carrier	Attenuation below carrier, dBc
Emission mask C (Channel bandwidth 25.0 kHz, authorized bandwidth 20.0 kHz)	
0 – 5.0 kHz	0
5.0 – 10.0 kHz	0 – 25.0*
10.0 – 24.2 kHz	27.8 – 50.0*
24.2 – 50.0 kHz	50.0
More than 50.0 kHz	43+10logP(W)

* - linearly increase with frequency

7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

7.6.2.2 The emission mask was measured with spectrum analyzer as provided in the associated plots. The test results recorded in Table 7.6.2.

Figure 7.6.1 Emission mask test setup





HERMON LABORATORIES

Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16 - 12-Jan-16	
Temperature: 23 °C		Air Pressure: 1020 hPa	Relative Humidity: 56 %
Remarks: CBW 25 kHz		Power Supply: Battery	

Table 7.6.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450	Emission mask C	Pass
460		
470		

Reference numbers of test equipment used

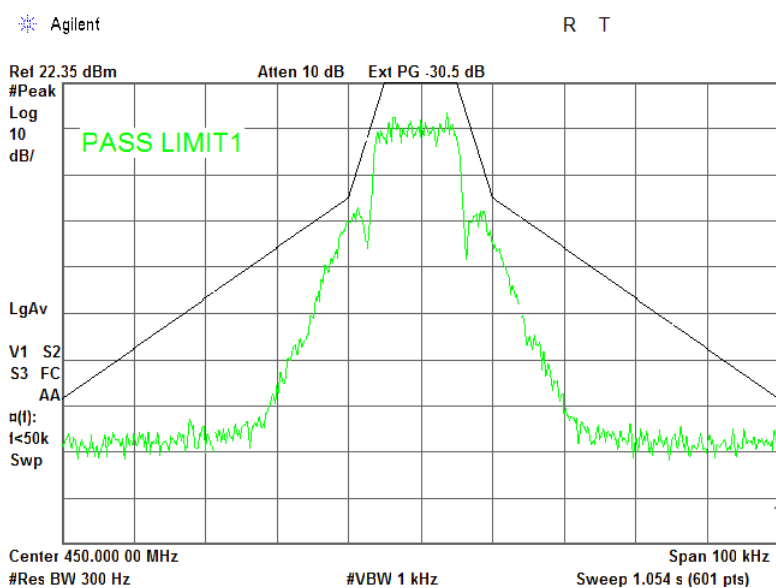
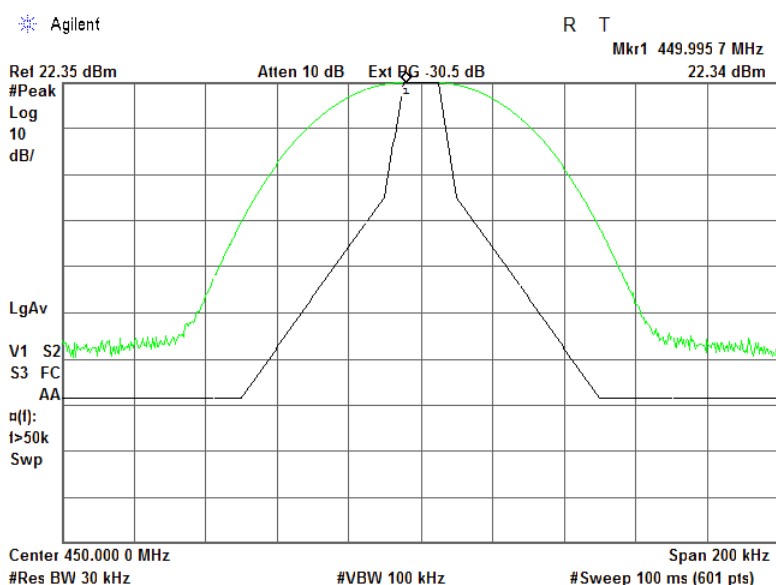
HL 2780	HL 3435	HL 3440	HL 3455	HL 4275
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Full description is given in Appendix A.

Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16 - 12-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.6.1 Emission mask test results at low carrier frequency

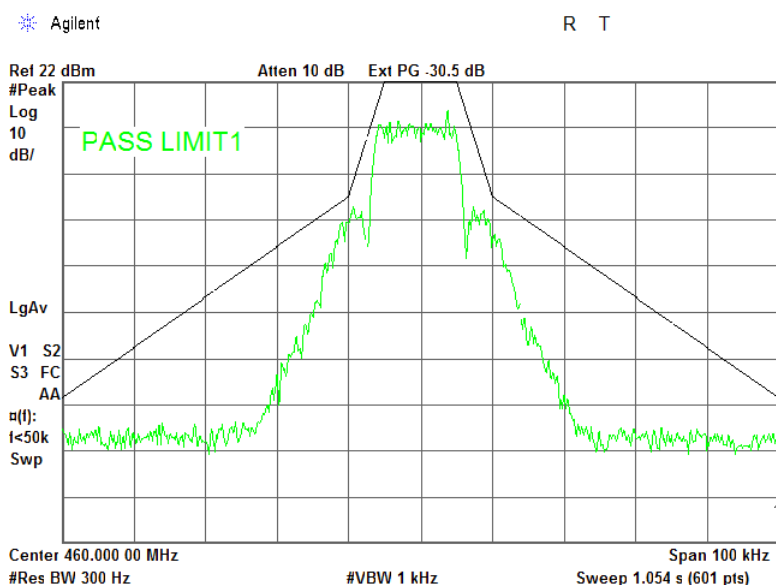
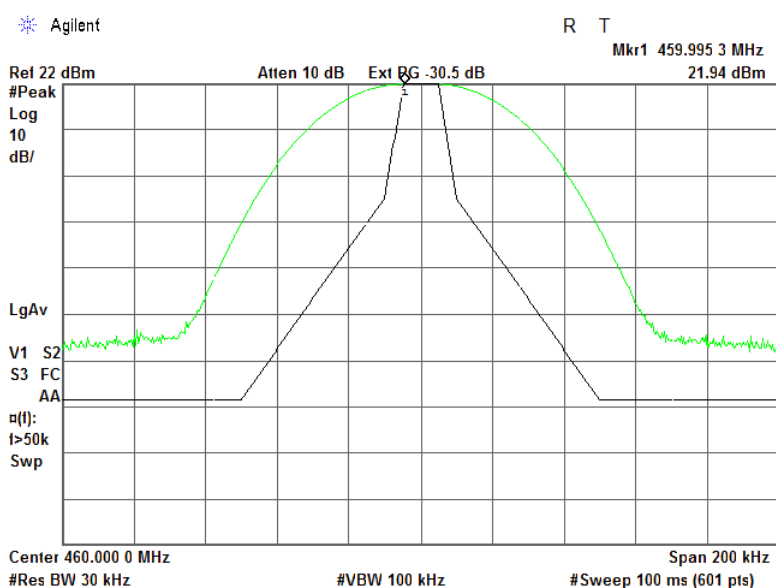
OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: GFSK
BIT RATE: 11 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16 - 12-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.6.2 Emission mask test results at mid carrier frequency

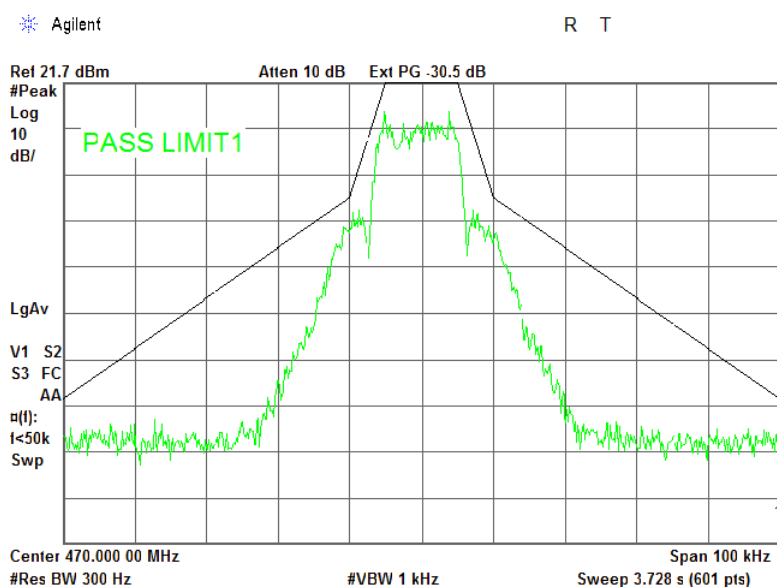
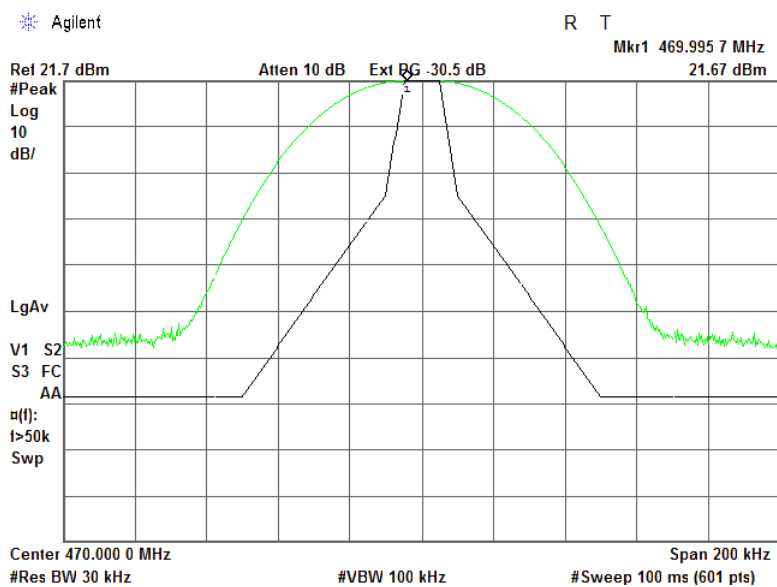
OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: GFSK
BIT RATE: 11 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



Test specification:		Section 90.210, Emission mask	
Test procedure:		47 CFR, Sections 2.1051, 2.1047 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		06-Jan-16 - 12-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.6.3 Emission mask test results at high carrier frequency

OPERATING FREQUENCY RANGE: 450-470 MHz
DETECTOR USED: Peak
MODULATION: GFSK
MODULATING SIGNAL: PRBS
BIT RATE: 11 kbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum





Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

7.7 Radiated spurious emission measurements for 12.5 kHz CBW

7.7.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)***
0.009 – 10th harmonic*	50+10logP**	-20	77.4

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

** - P is transmitter output power in Watts

*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows:
 $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

7.7.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and the performance check was conducted.

7.7.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.7.2.3 The worst test results (the lowest margins) were recorded in Table 7.7.2 and shown in the associated plots.

7.7.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.7.3.1 The EUT was set up as shown in Figure 7.7.2, energized and the performance check was conducted.

7.7.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.7.3.3 The worst test results (the lowest margins) were recorded in Table 7.7.2 and shown in the associated plots.

7.7.4 Test procedure for substitution ERP measurements of spurious

7.7.4.1 The test equipment was set up as shown in Figure 7.7.3 and energized.

7.7.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.7.4.3 The test antenna height was swept from 1 to 4 m to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.7.4.4 The above procedure was performed in both, horizontal and vertical, polarizations of the test and substitution antennas.

7.7.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

7.7.4.6 The above procedure was repeated at the rest of investigated frequencies.

7.7.4.7 The worst test results (the lowest margins) were recorded in Table 7.7.3 and shown in the associated plots.

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Figure 7.7.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

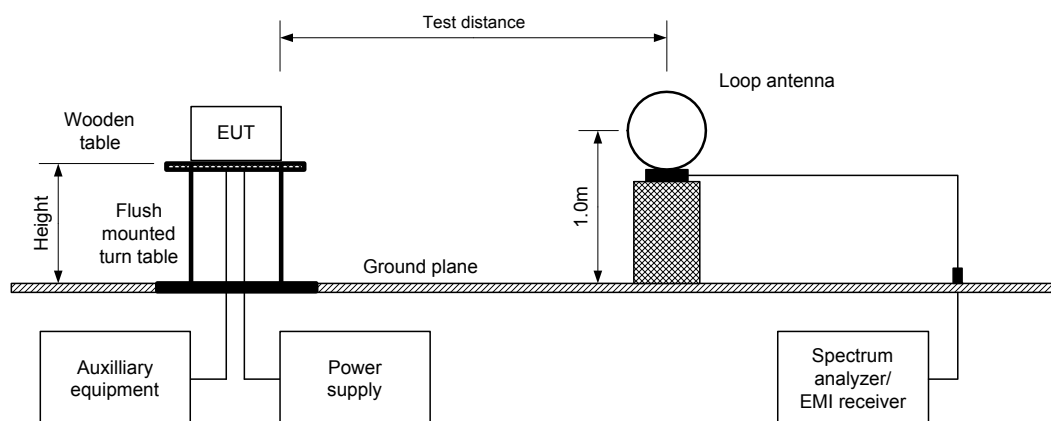
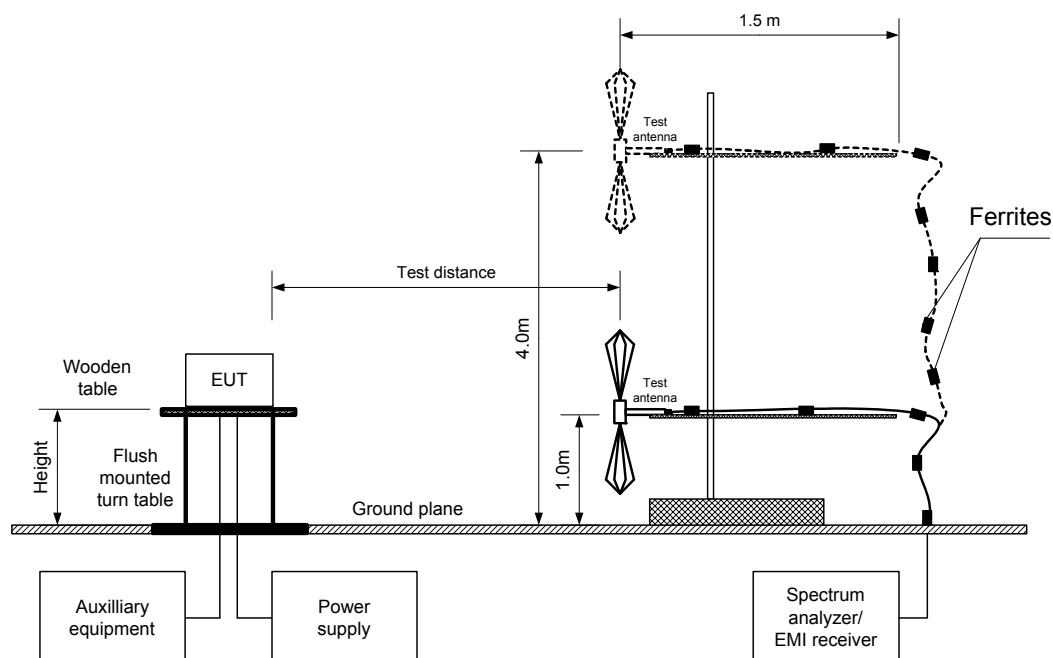
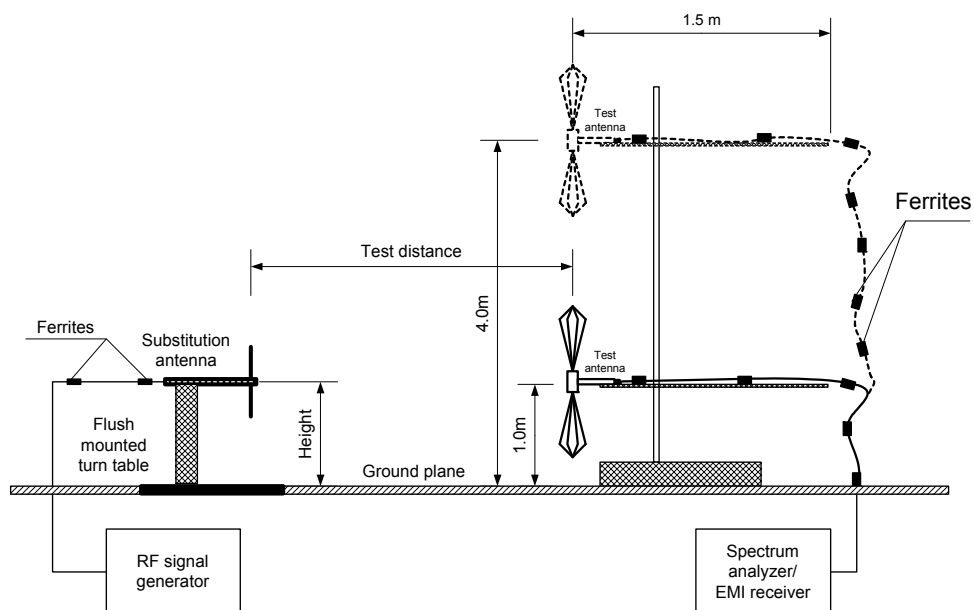


Figure 7.7.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Figure 7.7.3 Setup for substitution ERP measurements of spurious





Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Table 7.7.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 450-470 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)
 MODULATION: GFSK
 BIT RATE: 6.7 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
Low carrier frequency 450MHz							
900	56.70	77.4	-20.70	120	Vertical	1.1	80
1350	49.65	77.4	-27.75	1000	Horizontal	1.2	0
1800	53.85	77.4	-23.55	1000	Horizontal	1.4	180
2250	56.81	77.4	-20.59	1000	Horizontal	1.4	180
2700	53.52	77.4	-23.88	1000	Horizontal	1.4	180
3150	57.47	77.4	-19.93	1000	Horizontal	1.5	30
3600	53.34	77.4	-24.06	1000	Horizontal	1.3	0
Mid carrier frequency 460 MHz							
920	58.80	77.4	-18.60	120	Vertical	1.1	180
1380	51.73	77.4	-25.67	1000	Horizontal	1.3	130
1840	52.40	77.4	-25.00	1000	Horizontal	1.4	130
2300	57.16	77.4	-20.24	1000	Horizontal	1.5	110
2760	56.65	77.4	-20.75	1000	Horizontal	1.4	130
3220	55.87	77.4	-21.53	1000	Horizontal	1.5	30
3680	51.10	77.4	-26.30	1000	Horizontal	1.3	0
High carrier frequency 470 MHz							
940	58.30	77.4	-19.10	120	Vertical	1.1	180
1410	55.03	77.4	-22.37	1000	Horizontal	1.3	120
1880	54.06	77.4	-23.34	1000	Horizontal	1.4	120
2350	57.46	77.4	-19.94	1000	Horizontal	1.5	75
2820	57.18	77.4	-20.22	1000	Horizontal	1.5	80
3290	55.52	77.4	-21.88	1000	Horizontal	1.5	90
3760	51.32	77.4	-26.08	1000	Horizontal	1.4	75

*- Margin = Field strength of spurious – calculated field strength limit.

** - EUT front panel refers to 0 degrees position of turntable.



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Test specification:	Section 90.210, Radiated spurious emissions			
Test procedure:	47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12			
Test mode:	Compliance	Verdict: PASS		
Date(s):	04-Jan-16 - 13-Jan-16			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery	
Remarks: CBW 12.5 kHz				

Table 7.7.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 450-470 MHz
 TEST SITE: Semi anechoic chamber
 TEST DISTANCE: 3 m
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency										
900	56.70	120	Vertical	-36.8	-1.4	1.4	-39.6	-20	-19.6	Pass
1350	49.65	1000	Horizontal	-49.0	3.2	2.0	-47.8	-20	-27.8	Pass
1800	53.85	1000	Horizontal	-46.0	3.3	2.4	-45.1	-20	-25.1	Pass
2250	56.81	1000	Horizontal	-42.5	3.4	2.9	-42.0	-20	-22.0	Pass
2700	53.52	1000	Horizontal	-46.5	4.2	3.2	-45.5	-20	-25.5	Pass
3150	57.47	1000	Horizontal	-42.0	5.3	3.7	-40.4	-20	-20.4	Pass
3600	53.34	1000	Horizontal	-47.0	6.1	4.0	-44.9	-20	-24.9	Pass
Mid carrier frequency										
920	58.80	120	Vertical	-34.7	-1.4	1.4	-37.5	-20	-17.5	Pass
1380	51.73	1000	Horizontal	-47.0	3.2	2.0	-45.8	-20	-25.8	Pass
1840	52.40	1000	Horizontal	-47.0	3.3	2.4	-46.1	-20	-26.1	Pass
2300	57.16	1000	Horizontal	-42.0	3.4	2.9	-41.5	-20	-21.5	Pass
2760	56.65	1000	Horizontal	-43.5	4.2	3.2	-42.5	-20	-22.5	Pass
3220	55.87	1000	Horizontal	-44.0	5.3	3.7	-42.4	-20	-22.4	Pass
3680	51.10	1000	Horizontal	-49.0	6.1	4.0	-46.9	-20	-26.9	Pass
High carrier frequency										
940	58.30	120	Vertical	-35.2	-1.4	1.4	-38.0	-20	-18.0	Pass
1410	55.03	1000	Horizontal	-44.0	3.2	2.0	-42.8	-20	-22.8	Pass
1880	54.06	1000	Horizontal	-46.0	3.3	2.4	-45.1	-20	-25.1	Pass
2350	57.46	1000	Horizontal	-42.0	3.4	2.9	-41.5	-20	-21.5	Pass
2820	57.18	1000	Horizontal	-42.5	4.2	3.2	-41.5	-20	-21.5	Pass
3290	55.52	1000	Horizontal	-44.0	5.3	3.7	-42.4	-20	-22.4	Pass
3760	51.32	1000	Horizontal	-49.0	6.1	4.0	-46.9	-20	-26.9	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 0446	HL 0521	HL 0567	HL 0604	HL 0661	HL 1984	HL 4114	HL 4278
HL 4353	HL 4446						

Full description is given in Appendix A.

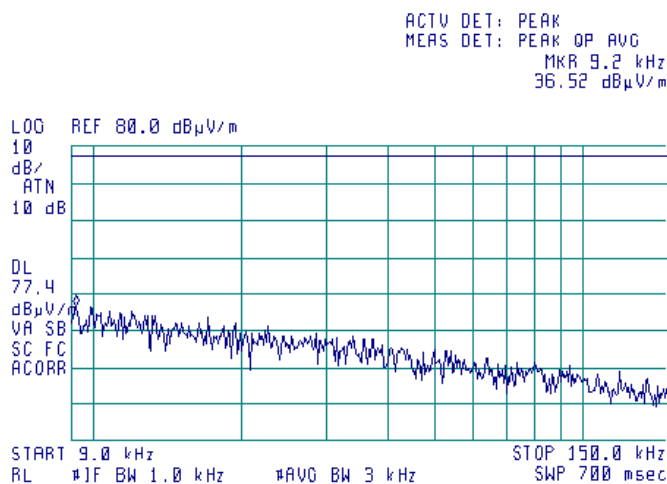


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Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

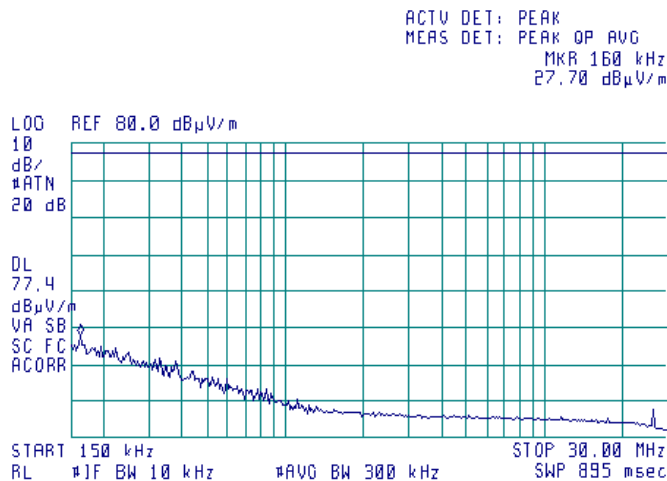
Plot 7.7.1 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Low, Mid, High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Plot 7.7.2 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Low, Mid, High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



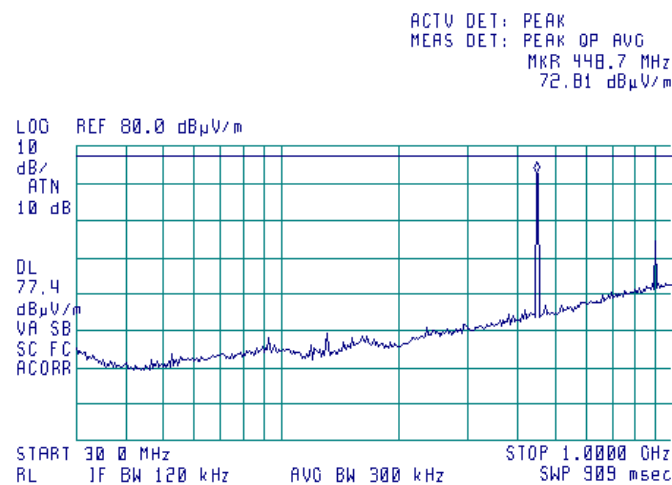


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

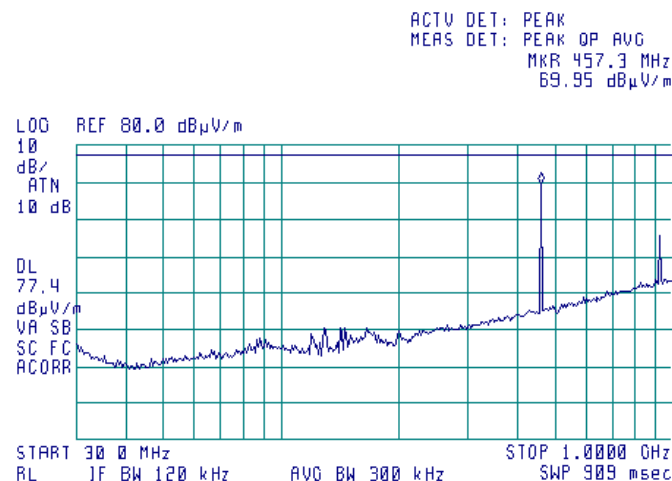
Plot 7.7.3 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



Plot 7.7.4 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



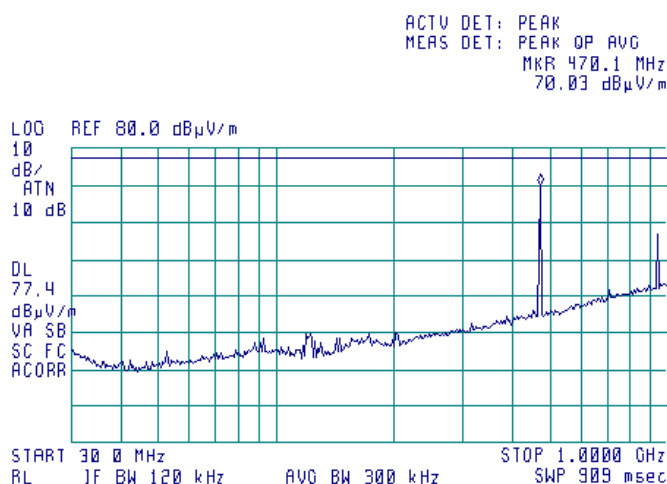


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

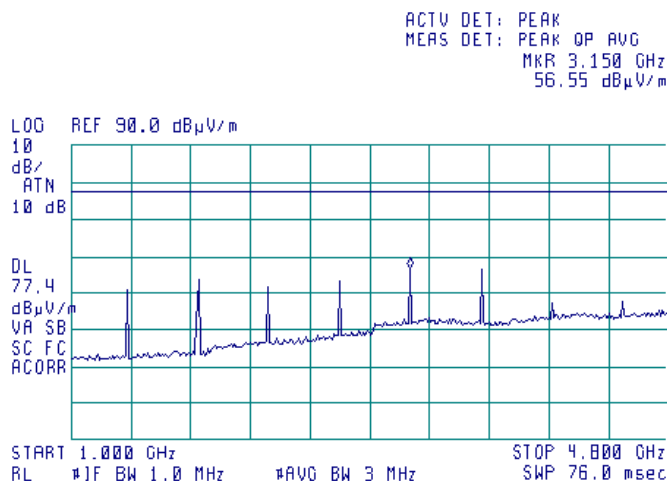
Plot 7.7.5 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High



Plot 7.7.6 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low





HERMON LABORATORIES

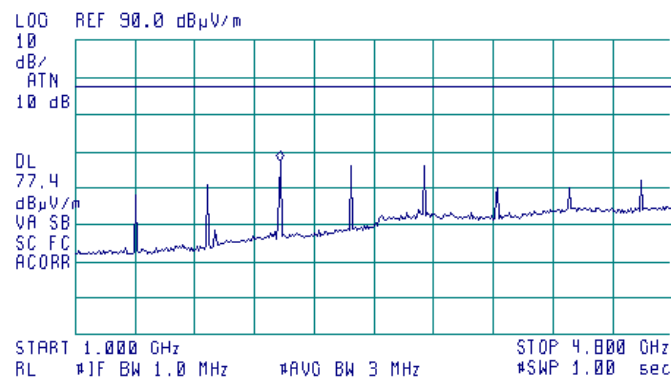
Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.7.7 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.303 GHz
57.20 dBμV/m

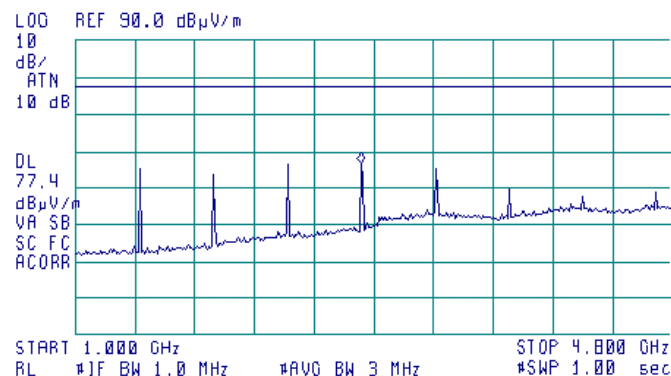


Plot 7.7.8 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 2.817 GHz
56.46 dBμV/m



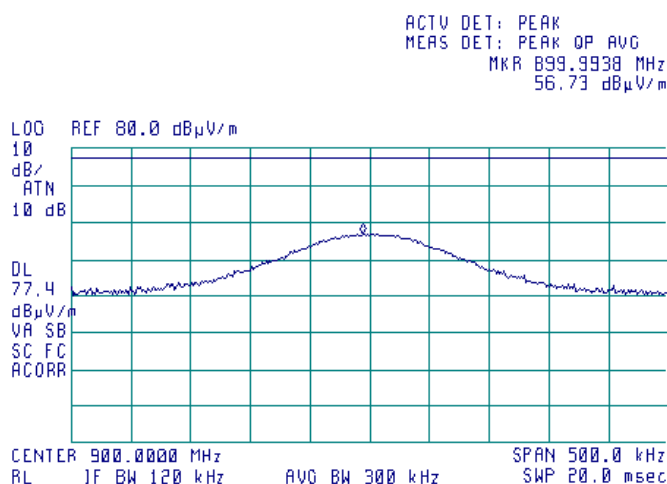


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

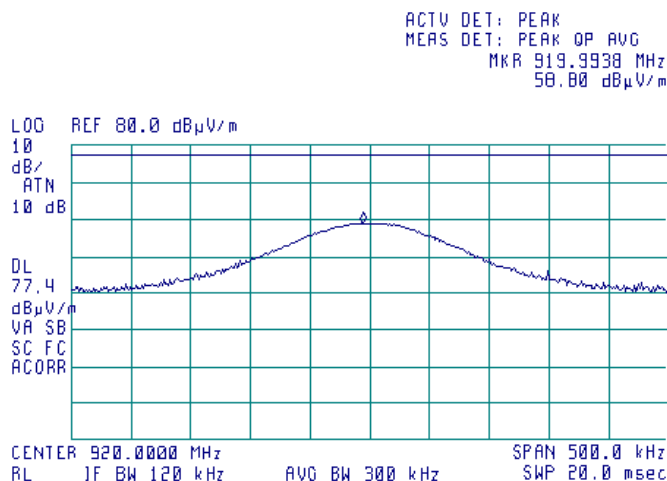
Plot 7.7.9 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



Plot 7.7.10 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



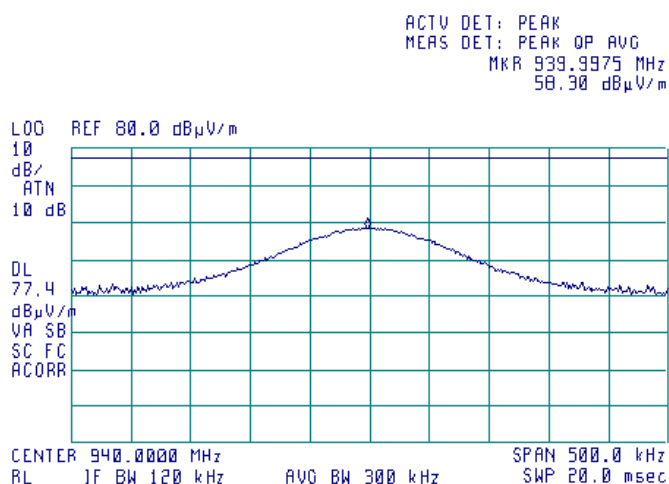


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

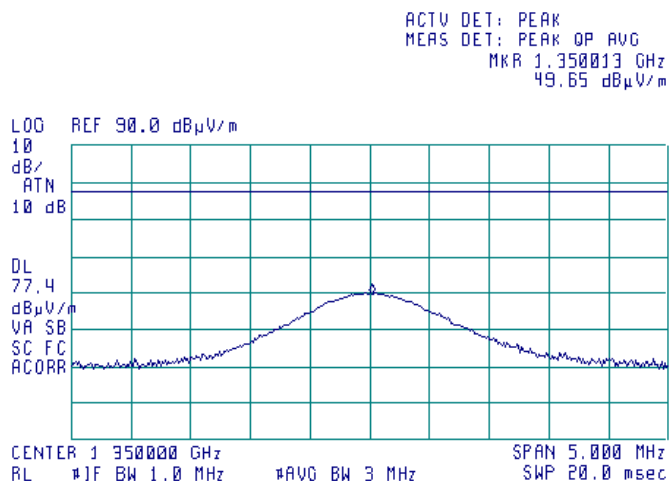
Plot 7.7.11 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High



Plot 7.7.12 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



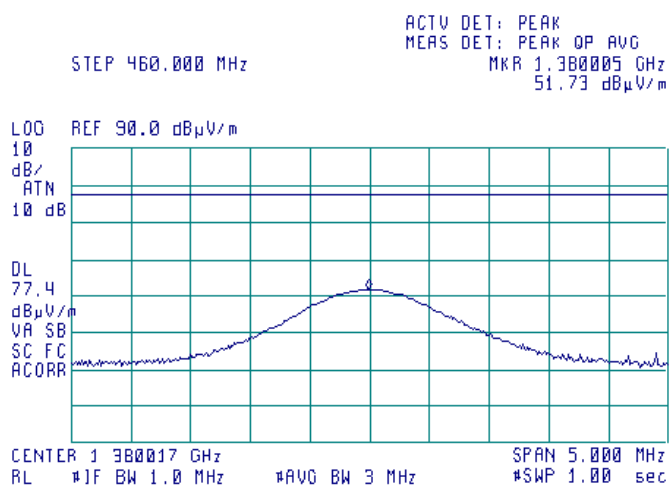


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

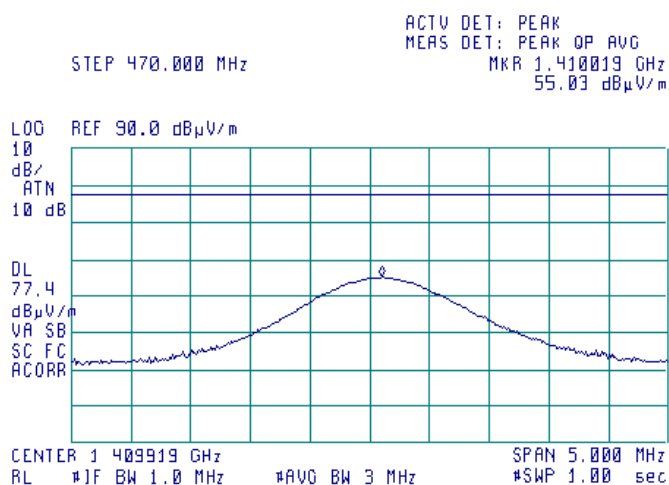
Plot 7.7.13 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



Plot 7.7.14 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High



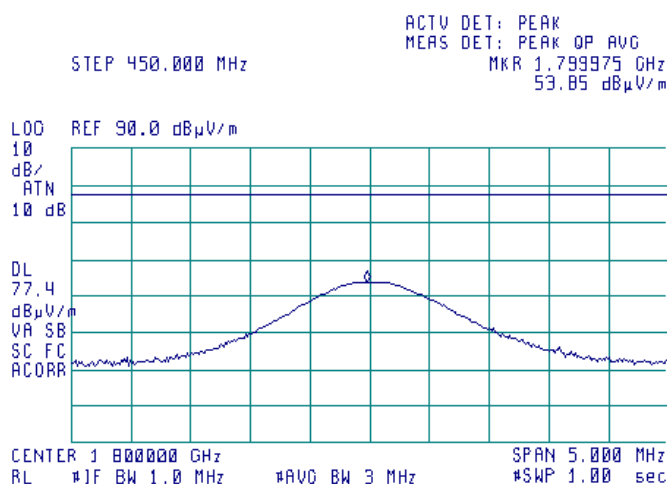


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

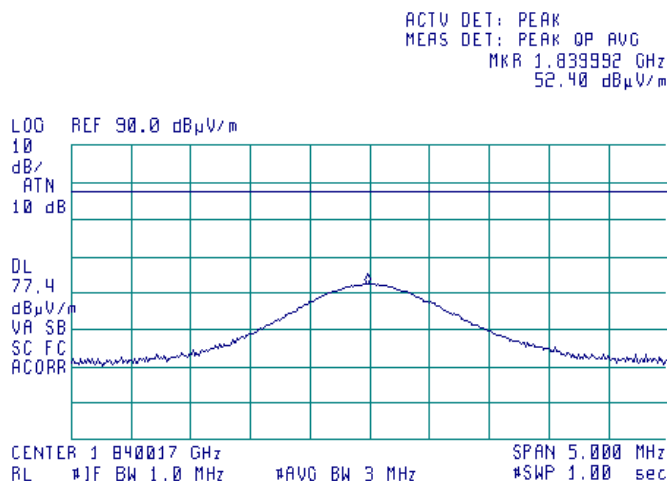
Plot 7.7.15 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



Plot 7.7.16 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



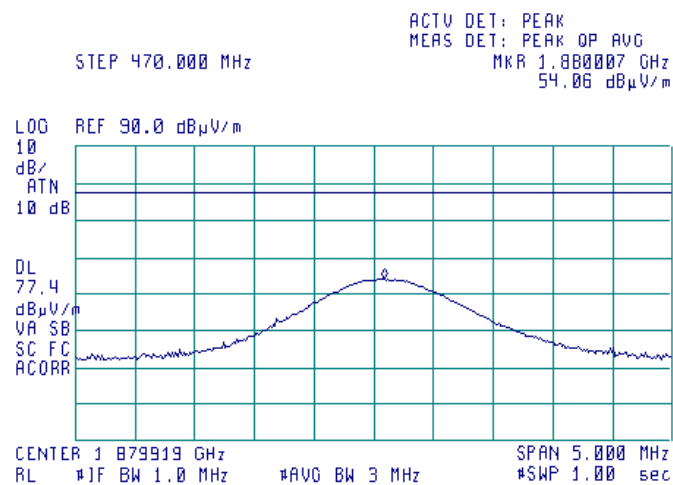


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

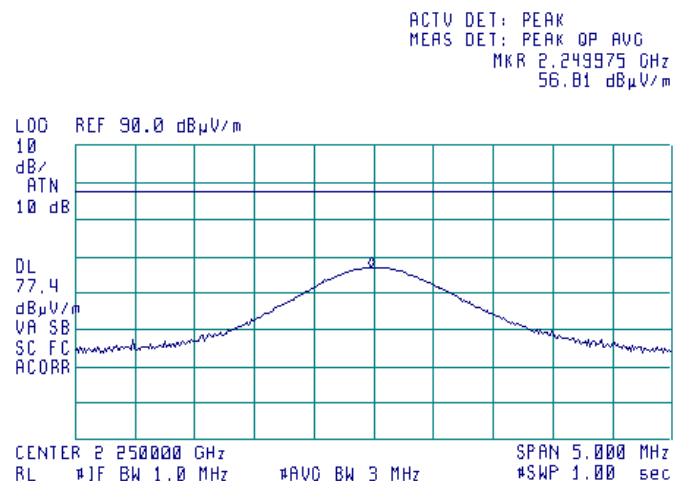
Plot 7.7.17 Radiated emission measurements at the 4th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High



Plot 7.7.18 Radiated emission measurements at the 5th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



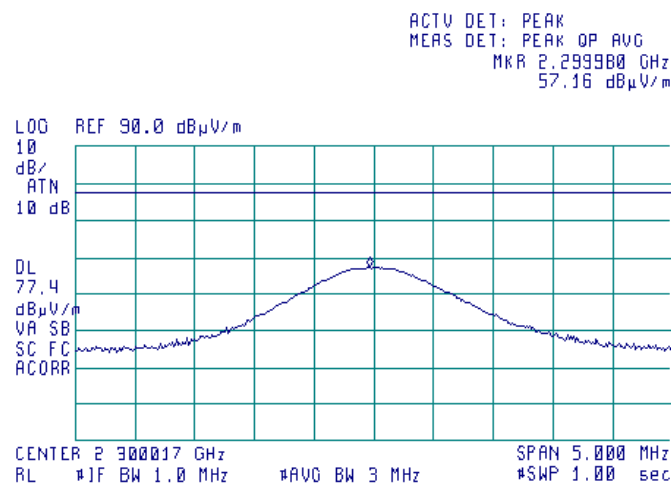


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

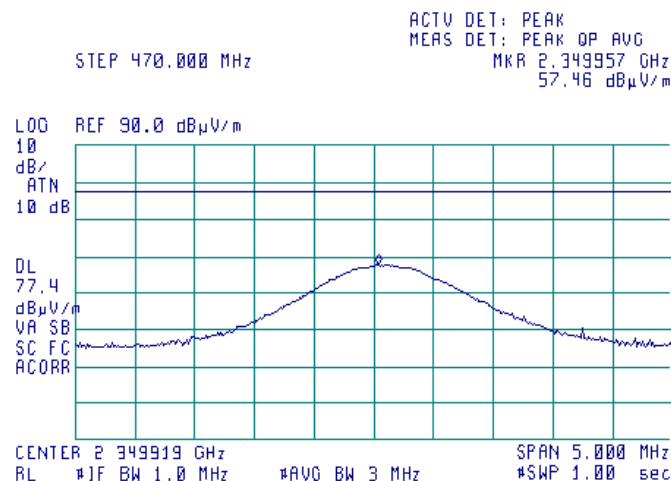
Plot 7.7.19 Radiated emission measurements at the 5th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



Plot 7.7.20 Radiated emission measurements at the 5th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High



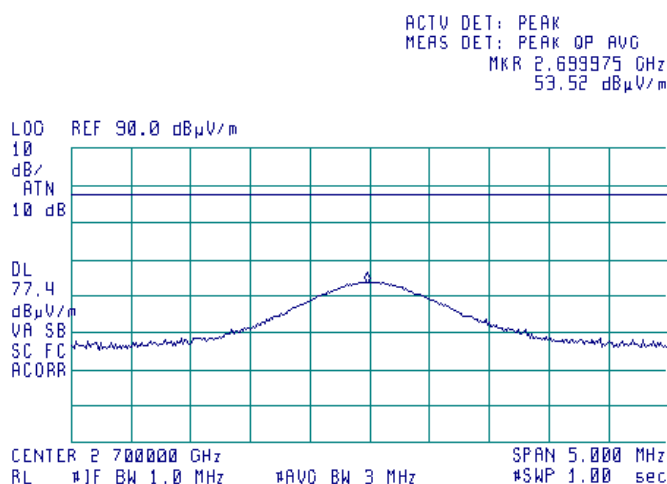


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

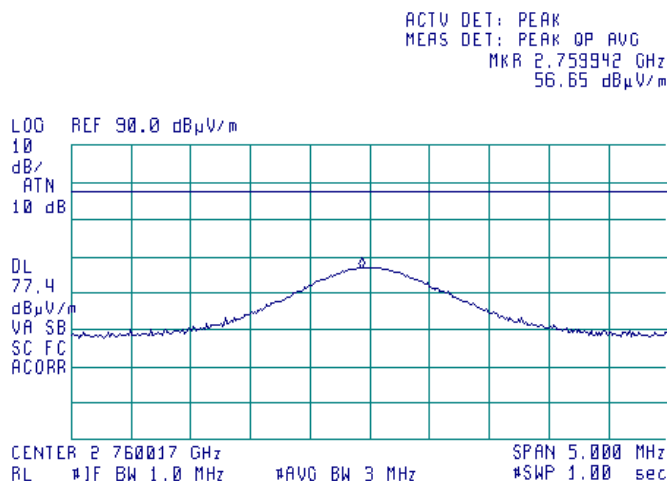
Plot 7.7.21 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



Plot 7.7.22 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



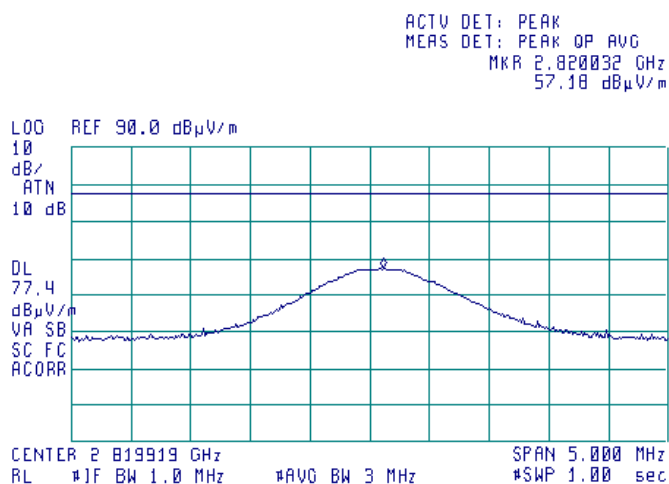


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

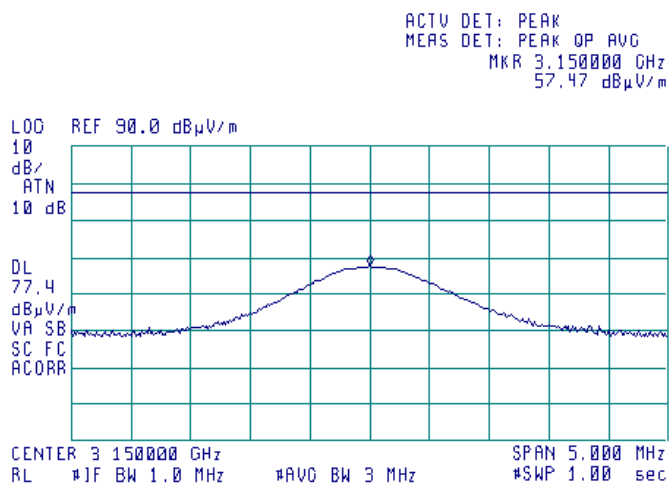
Plot 7.7.23 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High



Plot 7.7.24 Radiated emission measurements at the 7th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Low



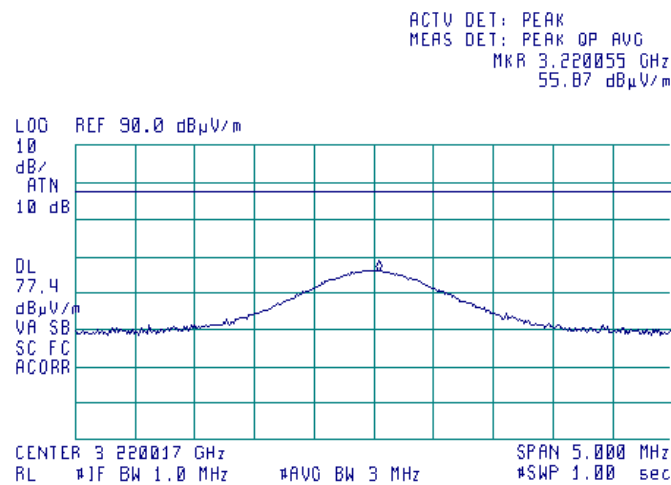


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

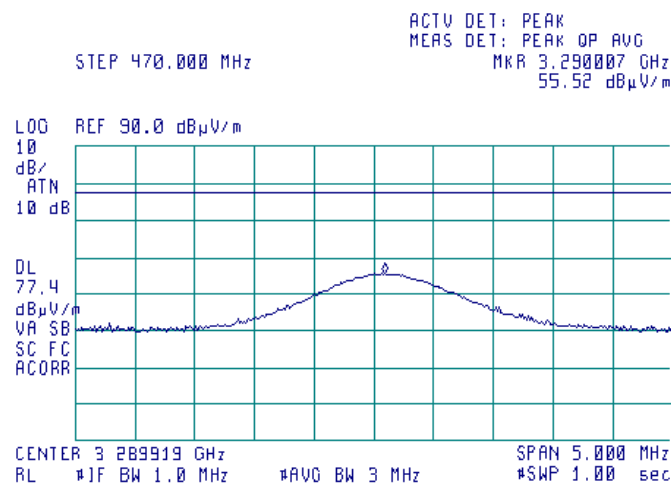
Plot 7.7.25 Radiated emission measurements at the 7th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: Mid



Plot 7.7.26 Radiated emission measurements at the 7th harmonic

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m
CARRIER FREQUENCY: High





HERMON LABORATORIES

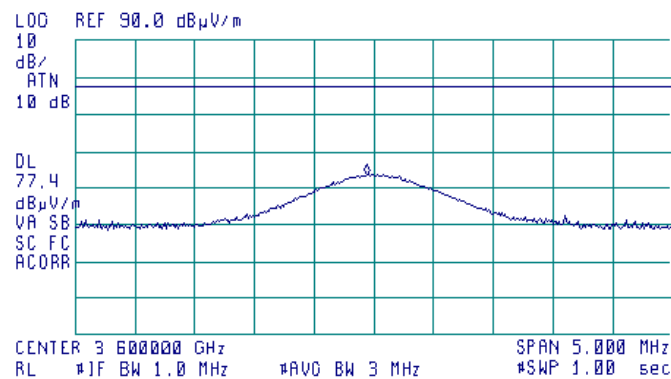
Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.7.27 Radiated emission measurements at the 8th harmonic

TEST SITE: Semi anechoic chamber
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m
 CARRIER FREQUENCY: Low



ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 3.599938 GHz
 53.34 dBμV/m

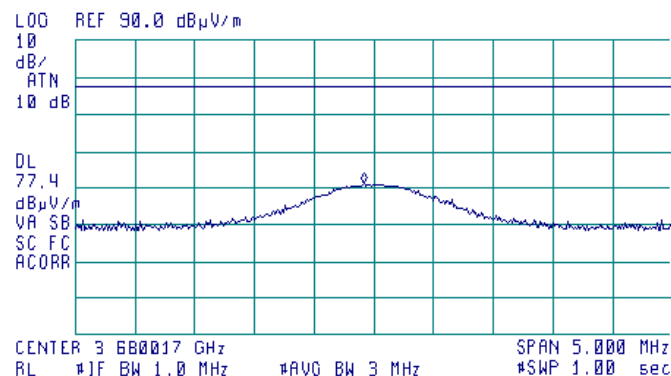


Plot 7.7.28 Radiated emission measurements at the 8th harmonic

TEST SITE: Semi anechoic chamber
 ANTENNA POLARIZATION: Vertical & Horizontal
 TEST DISTANCE: 3 m
 CARRIER FREQUENCY: Mid



ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 3.679938 GHz
 51.10 dBμV/m





HERMON LABORATORIES

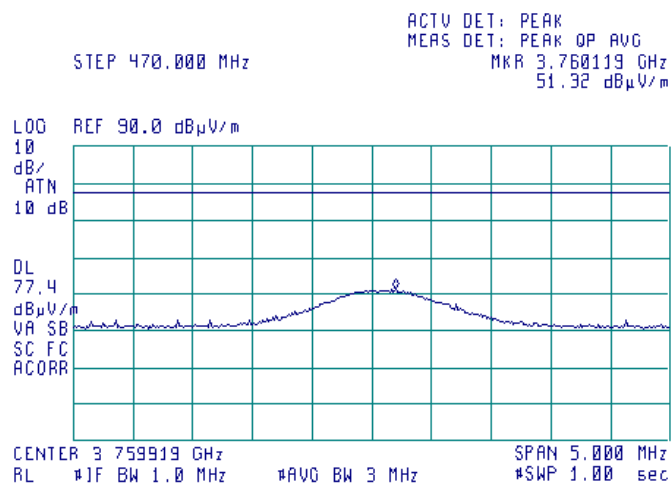
Report ID: METRAD_FCC.27772.docx

Date of Issue: 2-Mar-16

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		04-Jan-16 - 13-Jan-16	
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 57 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.7.29 Radiated emission measurements at the 8th harmonic

TEST SITE:	Semi anechoic chamber
ANTENNA POLARIZATION:	Vertical & Horizontal
TEST DISTANCE:	3 m
CARRIER FREQUENCY:	High





Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Verdict: PASS	
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

7.8 Radiated spurious emission measurements for 25 kHz CBW

7.8.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.8.1.

Table 7.8.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)***
0.009 – 10th harmonic*	43+10logP**	-13	84.4

* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

** - P is transmitter output power in Watts

*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: $E = \sqrt{30 \times P \times 1.64} / r$, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

7.8.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.8.2.1 The EUT was set up as shown in Figure 7.8.1, energized and the performance check was conducted.

7.8.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.8.2.3 The worst test results (the lowest margins) were recorded in Table 7.8.2 and shown in the associated plots.

7.8.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.8.3.1 The EUT was set up as shown in Figure 7.8.2, energized and the performance check was conducted.

7.8.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.8.3.3 The worst test results (the lowest margins) were recorded in Table 7.8.2 and shown in the associated plots.

7.8.4 Test procedure for substitution ERP measurements of spurious

7.8.4.1 The test equipment was set up as shown in Figure 7.8.3 and energized.

7.8.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.8.4.3 The test antenna height was swept from 1 to 4 m to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.8.4.4 The above procedure was performed in both, horizontal and vertical, polarizations of the test and substitution antennas.

7.8.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

7.8.4.6 The above procedure was repeated at the rest of investigated frequencies.

7.8.4.7 The worst test results (the lowest margins) were recorded in Table 7.8.3 and shown in the associated plots.

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

Figure 7.8.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

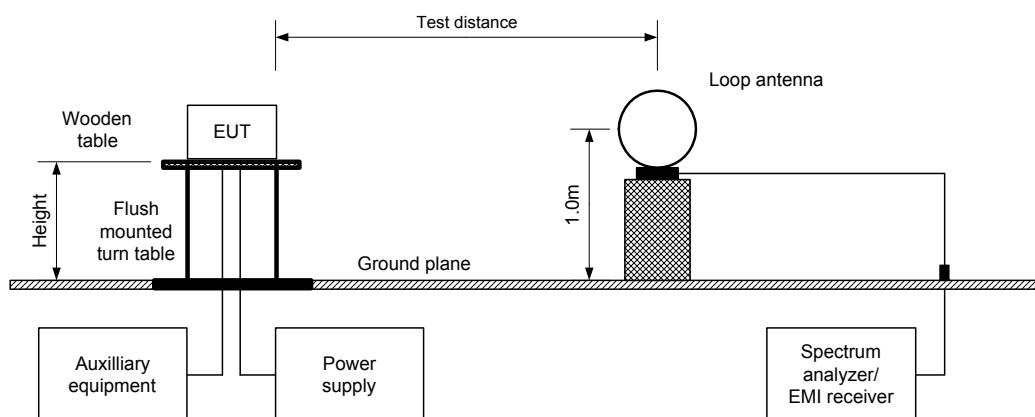
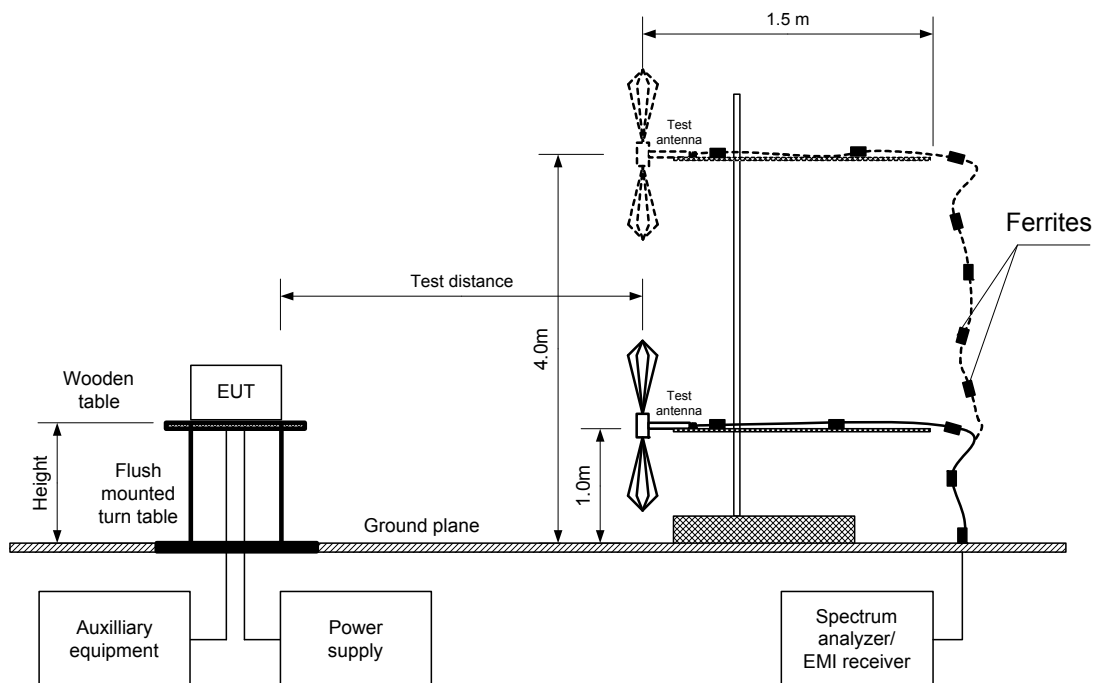
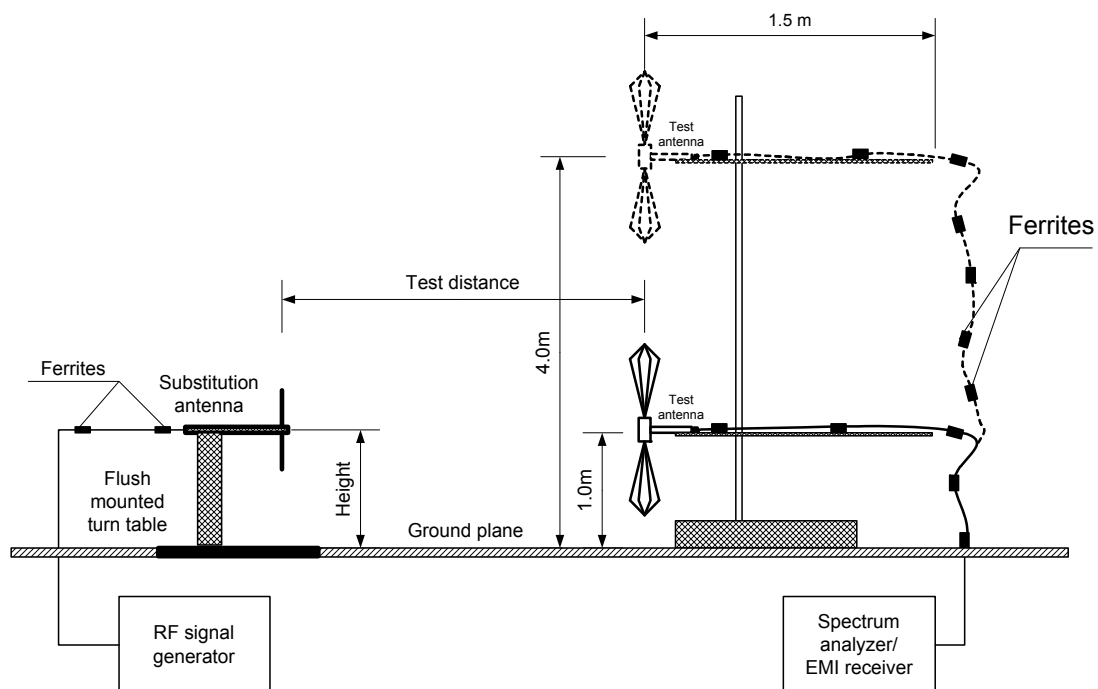


Figure 7.8.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

Figure 7.8.3 Setup for substitution ERP measurements of spurious





HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

Table 7.8.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 450-470 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 INVESTIGATED FREQUENCY RANGE: 0.009 – 2000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconical (30 MHz – 200 MHz)
 Double ridged guide (above 1000 MHz)
 MODULATION: GFSK
 BIT RATE: 11 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
Mid carrier frequency							
920	58.7	84.4	-25.7	120	Vertical	1.1	180
1380	53.0	84.4	-31.4	1000	Horizontal	1.3	130
1840	51.2	84.4	-33.2	1000	Horizontal	1.4	130
2300	57.2	84.4	-27.2	1000	Horizontal	1.5	110
2760	55.8	84.4	-28.6	1000	Horizontal	1.4	130
3220	54.0	84.4	-30.4	1000	Horizontal	1.5	30
3680	49.2	84.4	-35.2	1000	Horizontal	1.3	0

*- Margin = Field strength of spurious – calculated field strength limit.

** - EUT front panel refers to 0 degrees position of turntable.

Table 7.8.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 450-470 MHz
 TEST SITE: Semi anechoic chamber
 TEST DISTANCE: 3 m
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
Mid carrier frequency										
920	58.7	120	Vertical	-35.0	-1.4	1.4	-37.8	-13	-24.8	Pass
1380	53.0	1000	Horizontal	-46.0	3.2	2.0	-44.8	-13	-31.8	Pass
1840	51.2	1000	Horizontal	-48.0	3.3	2.4	-47.1	-13	-34.1	Pass
2300	57.2	1000	Horizontal	-42.0	3.4	2.9	-41.5	-13	-28.5	Pass
2760	55.8	1000	Horizontal	-44.4	4.2	3.2	-43.4	-13	-30.4	Pass
3220	54.0	1000	Horizontal	-46.0	5.3	3.7	-44.4	-13	-31.4	Pass
3680	49.2	1000	Horizontal	-51.0	6.1	4.0	-48.9	-13	-35.9	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 0446	HL 0521	HL 0567	HL 0604	HL 0661	HL 1984	HL 4114	HL 4278
HL 4353	HL 4446						

Full description is given in Appendix A.

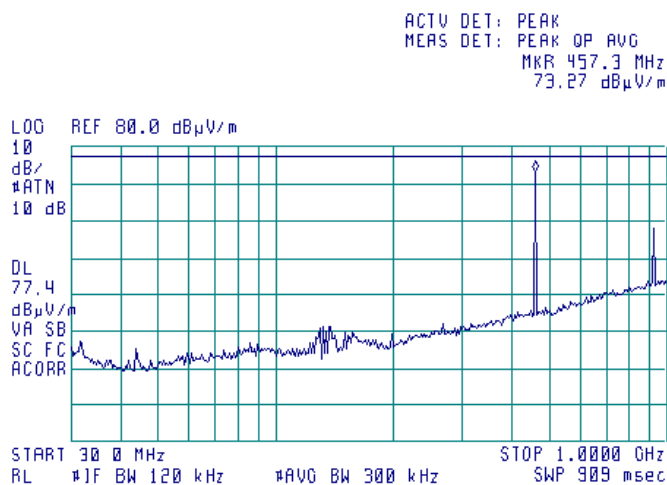


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

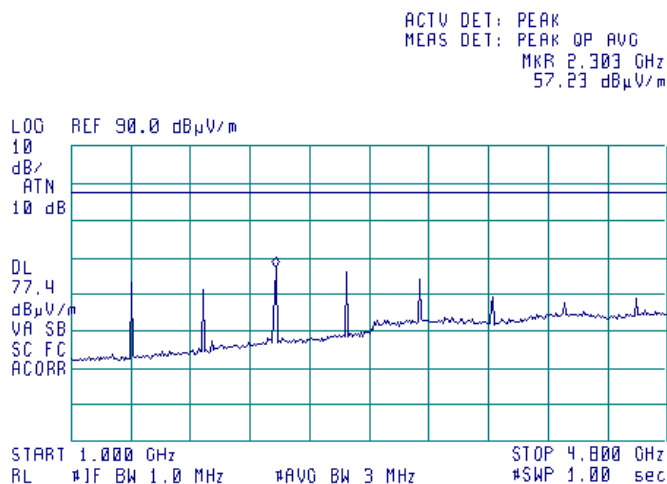
Plot 7.8.1 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Plot 7.8.2 Radiated emission measurements in 1000 – 4800 MHz range

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



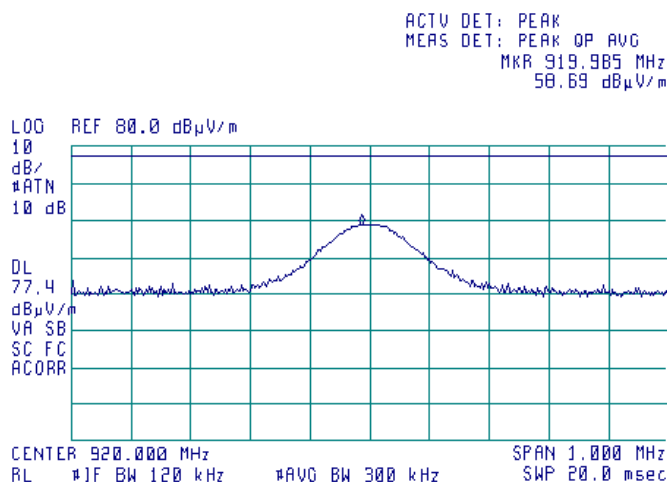


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

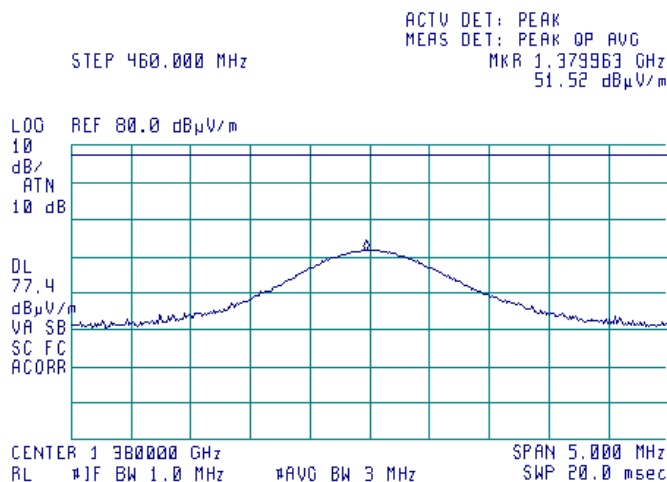
Plot 7.8.3 Radiated emission measurements at the 2nd harmonic

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.8.4 Radiated emission measurements at the 3rd harmonic

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



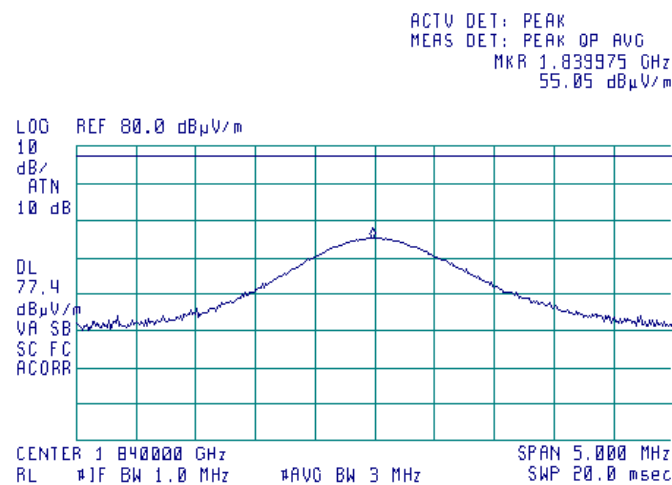


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

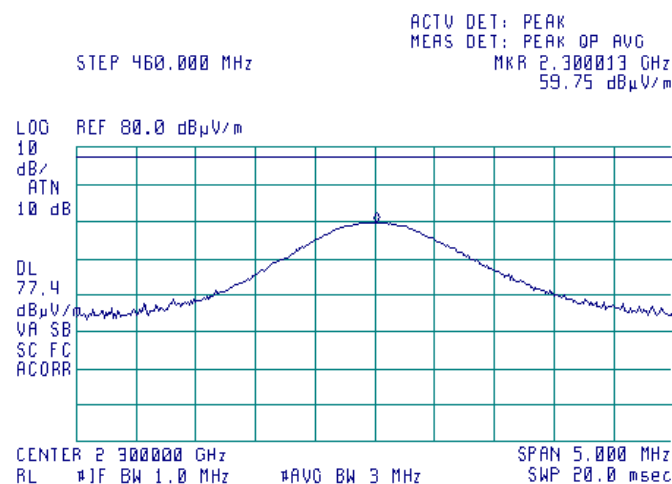
Plot 7.8.5 Radiated emission measurements at the 4th harmonic

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical & Horizontal
TEST DISTANCE:	3 m



Plot 7.8.6 Radiated emission measurements at the 5th harmonic

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical & Horizontal
TEST DISTANCE:	3 m



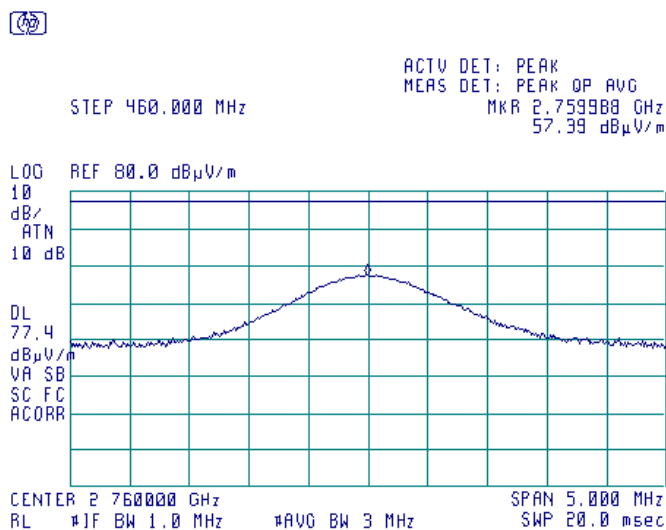


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

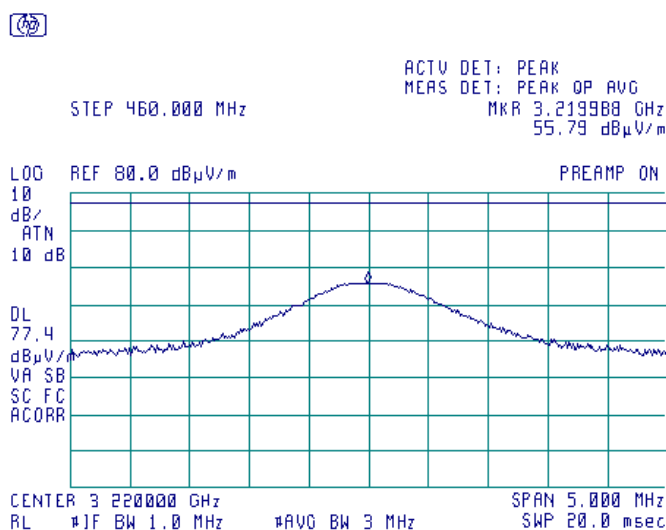
Plot 7.8.7 Radiated emission measurements at the 6th harmonic

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Plot 7.8.8 Radiated emission measurements at the 7th harmonic

TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



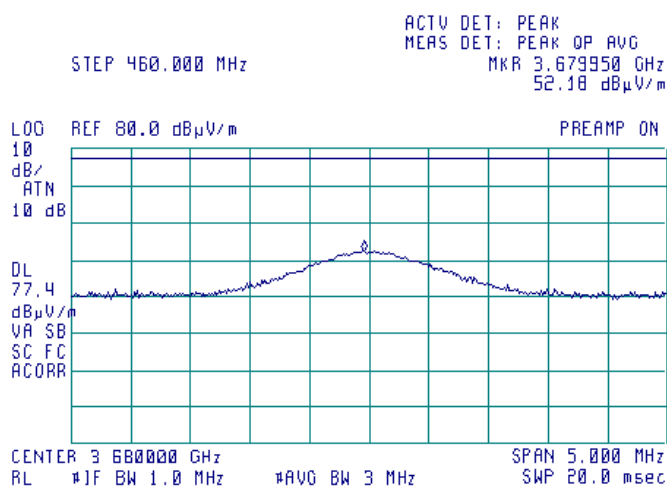


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Verdict: PASS	
Compliance			
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

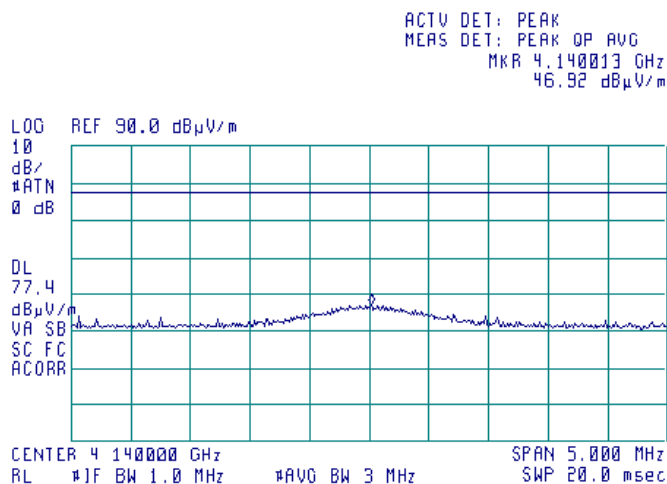
Plot 7.8.9 Radiated emission measurements at the 8th harmonic

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical & Horizontal
TEST DISTANCE:	3 m



Plot 7.8.10 Radiated emission measurements at the 9th harmonic

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical & Horizontal
TEST DISTANCE:	3 m



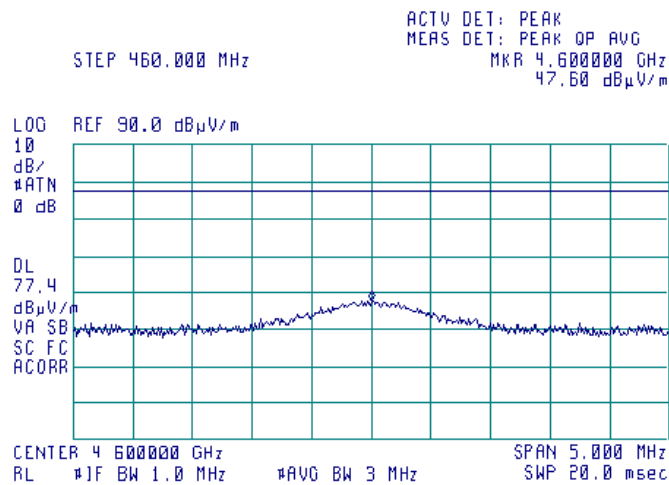


HERMON LABORATORIES

Test specification:		Section 90.210, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(d); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):			
Temperature: 23 °C	Air Pressure: 1010 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz, on Mid frequency only			

Plot 7.8.11 Radiated emission measurements at the 10th harmonic

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical & Horizontal
TEST DISTANCE:	3 m



Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

7.9 Spurious emissions at RF antenna connector test for 12.5 kHz CBW

7.9.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.9.1.

Table 7.9.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm
0.009 – 10th harmonic*	50+10logP** (mask D)	-20.0

* - spurious emission limits do not apply to the in band emission within ± 250 % of the authorized bandwidth from the carrier; investigated in course of emission mask testing

** - P is transmitter output power in Watts

7.9.2 Test procedure

7.9.2.1 The EUT was set up as shown in Figure 7.9.1, energized and its proper operation was checked.

7.9.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.9.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.9.2 and the associated plots.

Figure 7.9.1 Spurious emission test setup





Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Table 7.9.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 450-470 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 MODULATION: GFSK
 BIT RATE: 6.7 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
900	-36.04	included	included	120	-36.04	-20	-16.04	Pass
1350	-36.98	included	included	1000	-36.98	-20	-16.98	Pass
2450	-42.68	included	included	1000	-42.68	-20	-22.68	Pass
4500	-43.92	included	included	1000	-43.92	-20	-23.92	Pass
Mid carrier frequency								
920	-36.75	included	included	120	-36.75	-20	-16.75	Pass
1380	-36.96	included	included	1000	-36.96	-20	-16.96	Pass
2300	-42.17	included	included	1000	-42.17	-20	-22.17	Pass
4600	-42.47	included	included	1000	-42.47	-20	-22.47	Pass
High carrier frequency								
940	-37.60	included	included	120	-37.60	-20	-17.60	Pass
1410	-37.70	included	included	1000	-37.70	-20	-17.70	Pass
2350	-42.17	included	included	1000	-42.17	-20	-22.17	Pass
4700	-43.01	included	included	1000	-43.01	-20	-23.01	Pass

*- Margin = Spurious emission – specification limit.

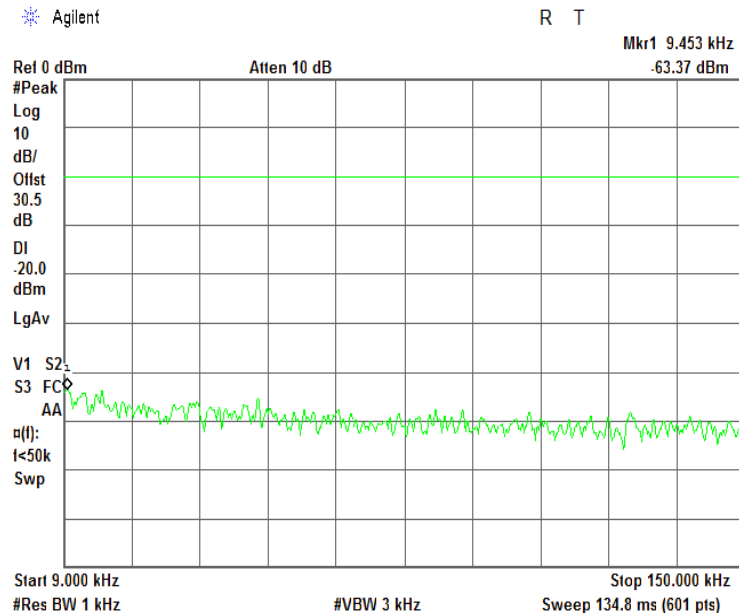
Reference numbers of test equipment used

HL 3433	HL 3818	HL 4068				
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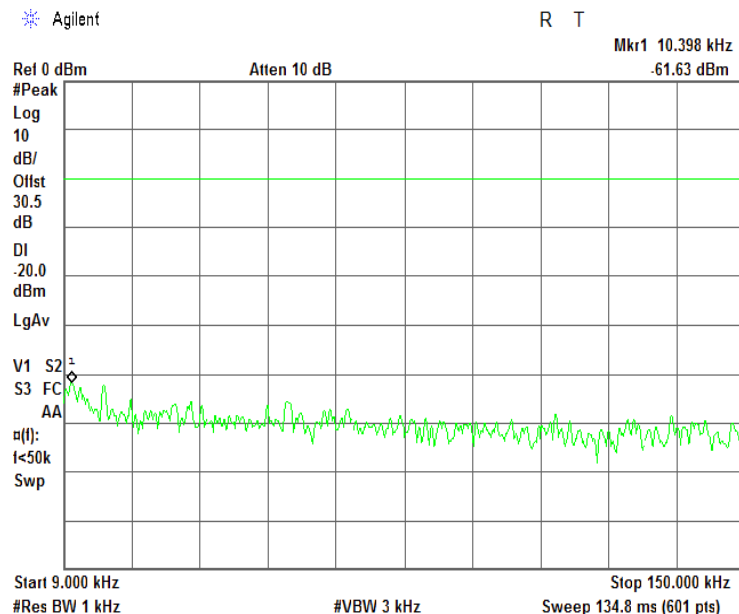
Full description is given in Appendix A.

Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

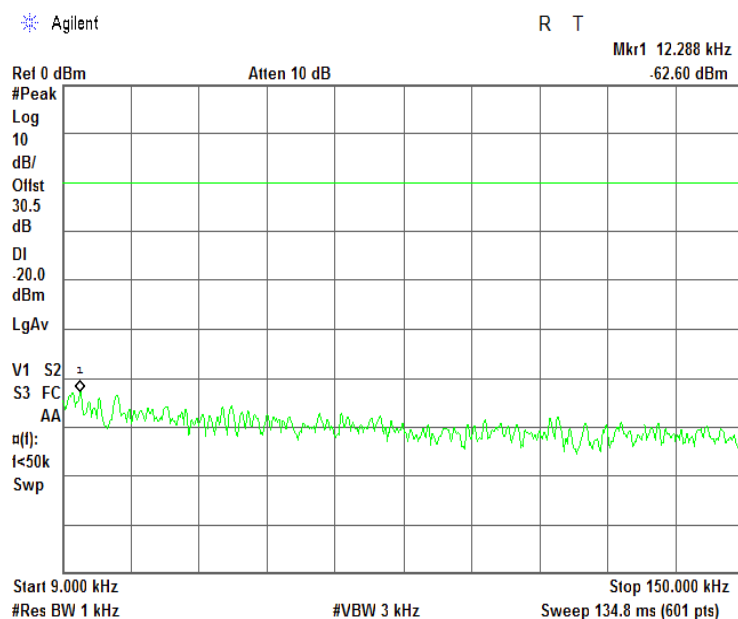


Plot 7.9.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency

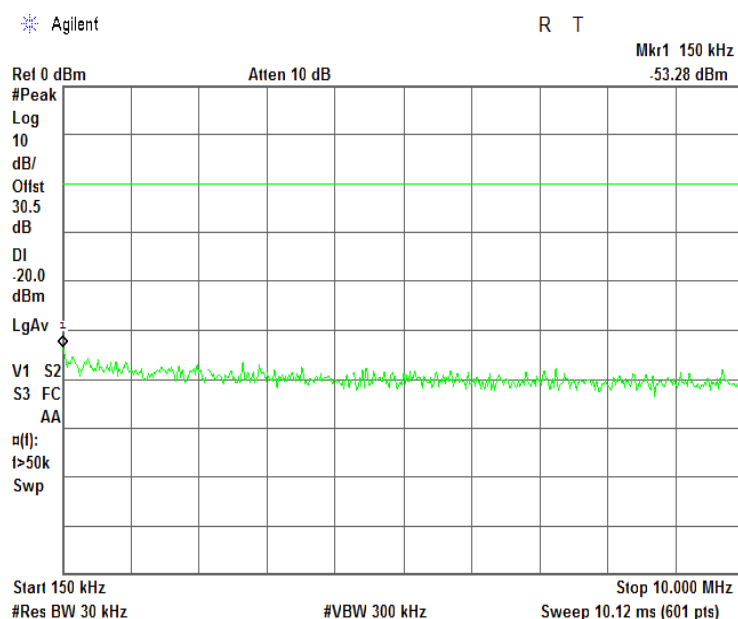


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.3 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

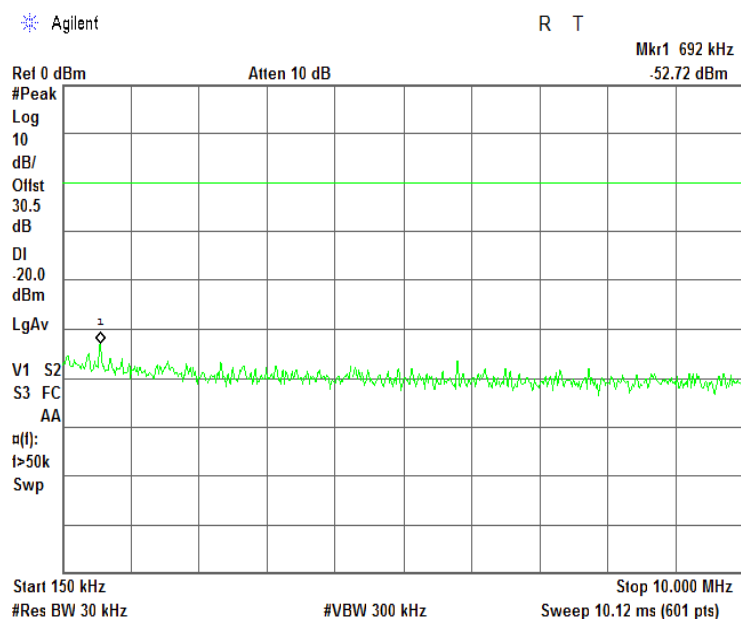


Plot 7.9.4 Spurious emission measurements in 0.15 - 10.0 MHz range at low carrier frequency

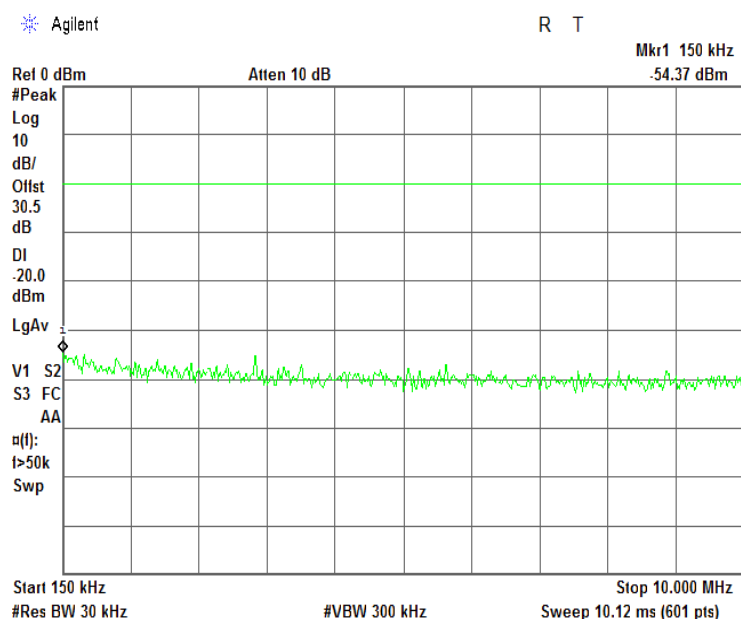


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.5 Spurious emission measurements in 0.15 - 10.0 MHz range at mid carrier frequency

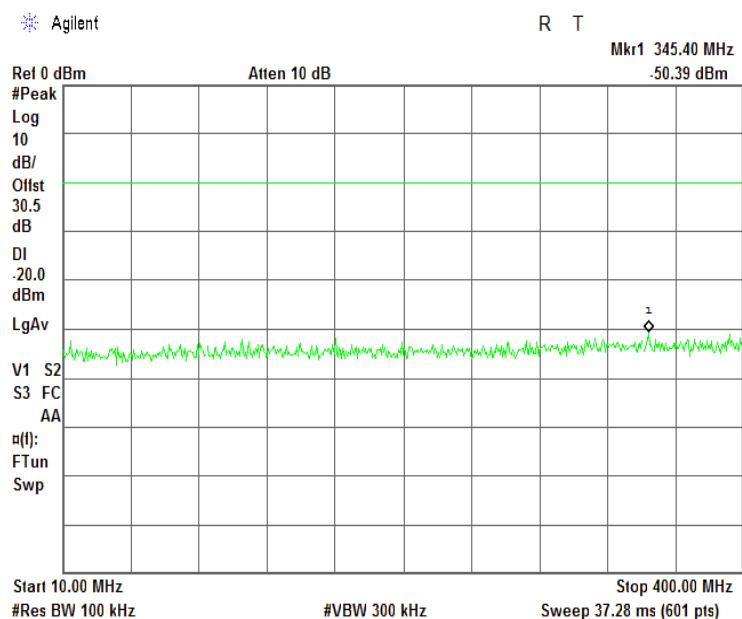


Plot 7.9.6 Spurious emission measurements in 0.15 - 10.0 MHz range at high carrier frequency

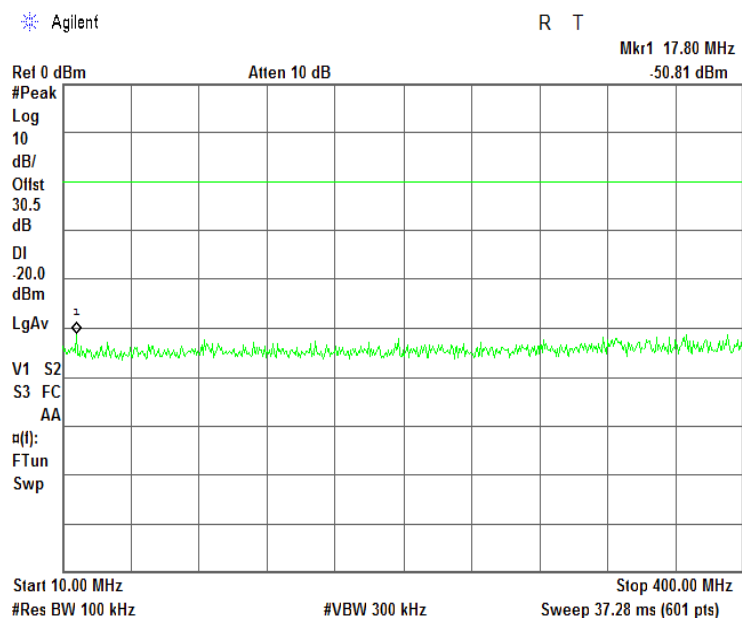


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.7 Spurious emission measurements in 10 - 400 MHz range at low carrier frequency

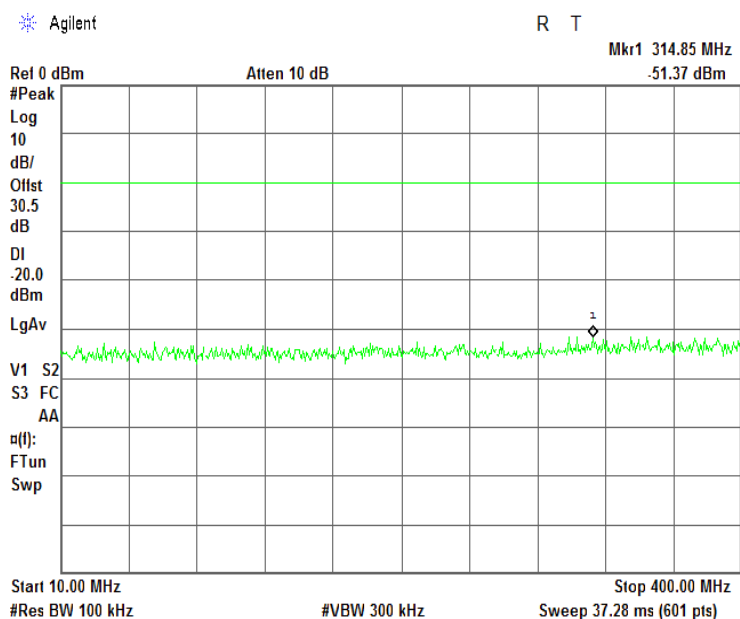


Plot 7.9.8 Spurious emission measurements in 10 - 400 MHz range at mid carrier frequency

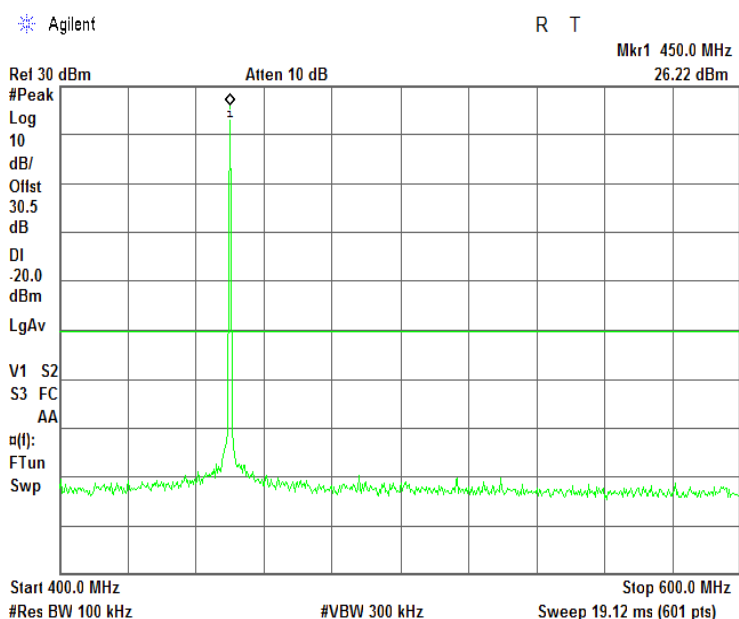


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.9 Spurious emission measurements in 10 - 400 MHz range at high carrier frequency

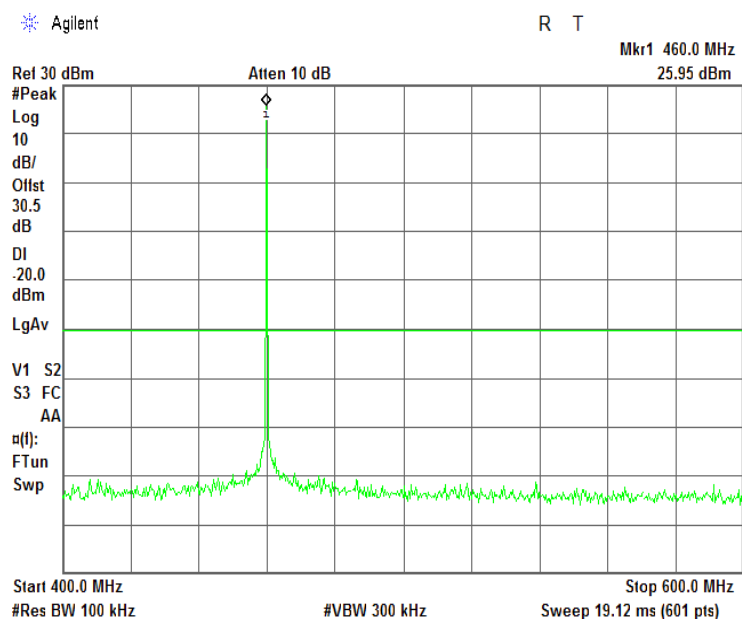


Plot 7.9.10 Spurious emission measurements in 400 - 600 MHz range at low carrier frequency

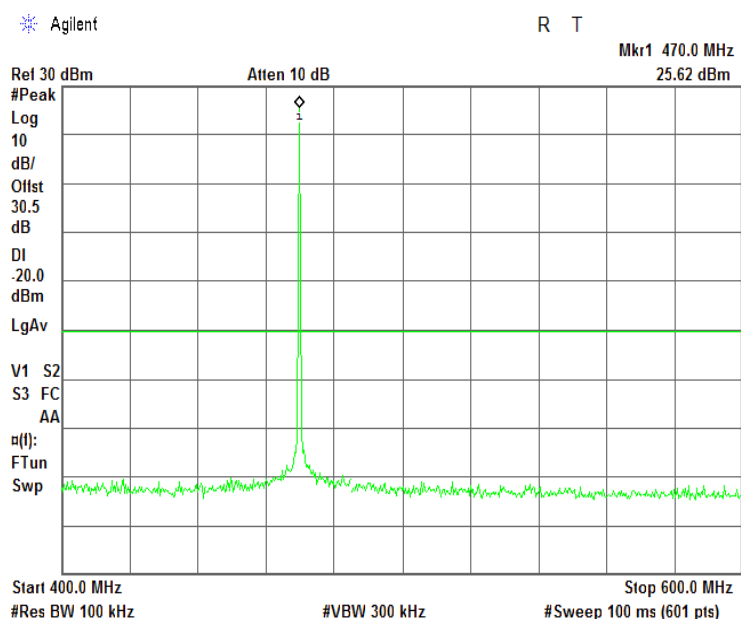


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.11 Spurious emission measurements in 400 - 600 MHz range at mid carrier frequency

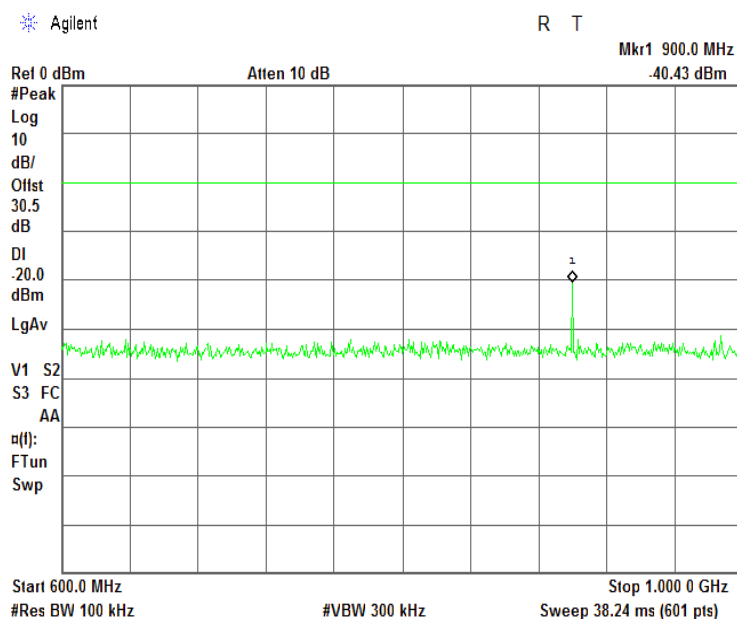


Plot 7.9.12 Spurious emission measurements in 400 - 600 MHz range at high carrier frequency

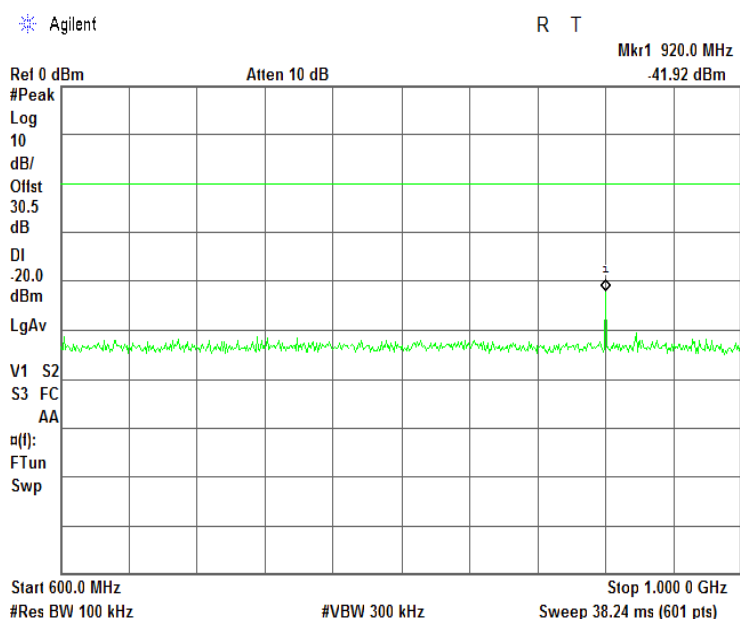


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.13 Spurious emission measurements in 600 - 1000 MHz range at low carrier frequency

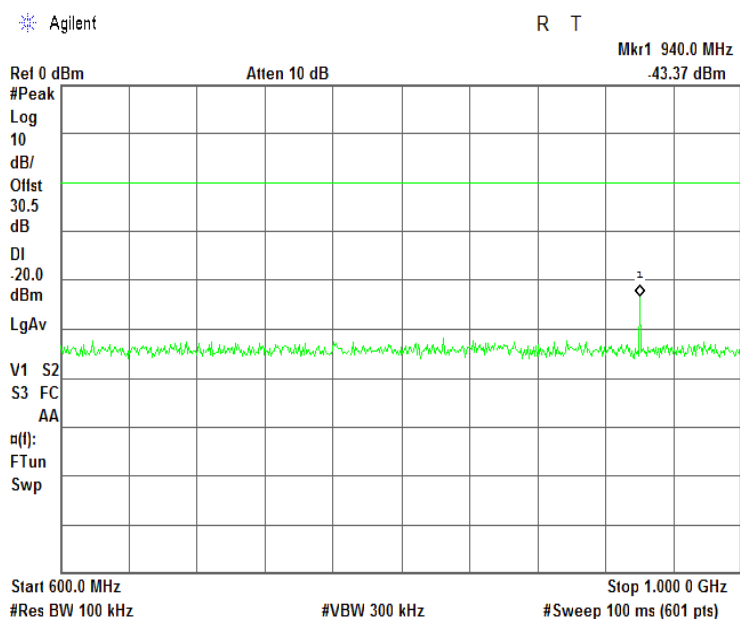


Plot 7.9.14 Spurious emission measurements in 600 - 1000 MHz range at mid carrier frequency

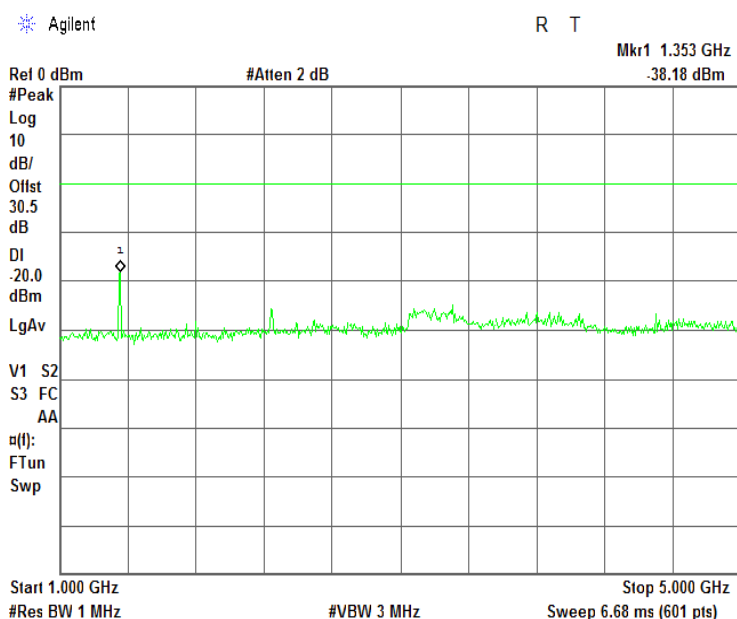


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.15 Spurious emission measurements in 600 - 1000 MHz range at high carrier frequency

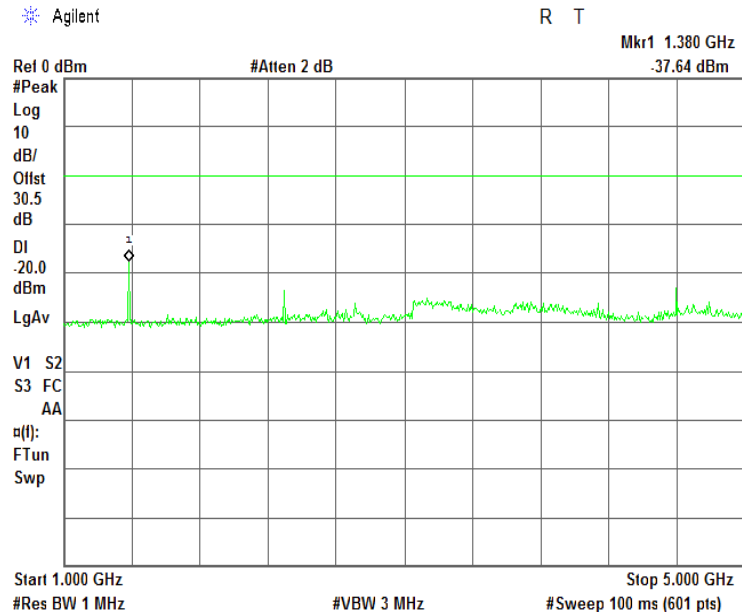


Plot 7.9.16 Spurious emission measurements in 1000 - 5000 MHz range at low carrier frequency

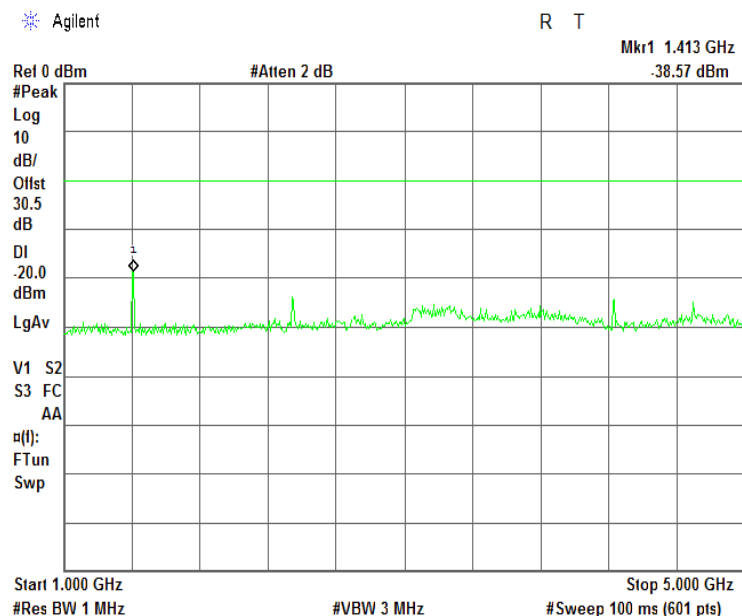


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.17 Spurious emission measurements in 1000 - 5000 MHz range at mid carrier frequency

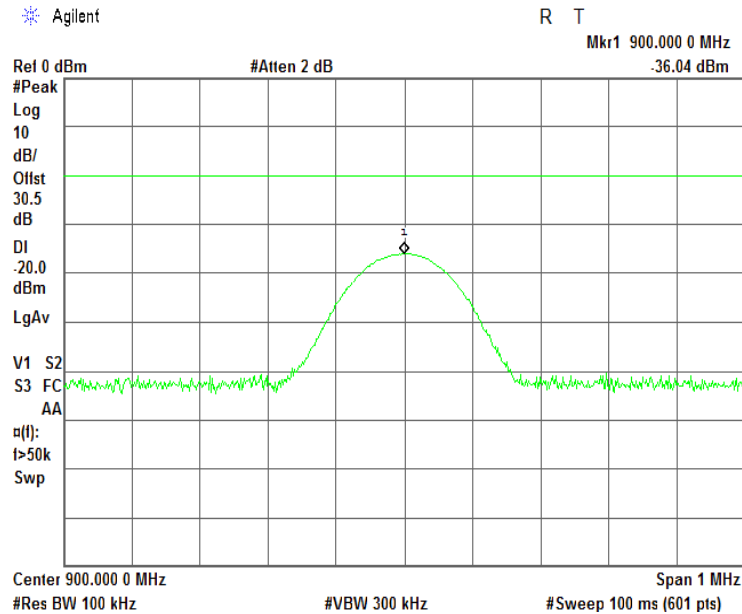


Plot 7.9.18 Spurious emission measurements in 1000 - 5000 MHz range at high carrier frequency

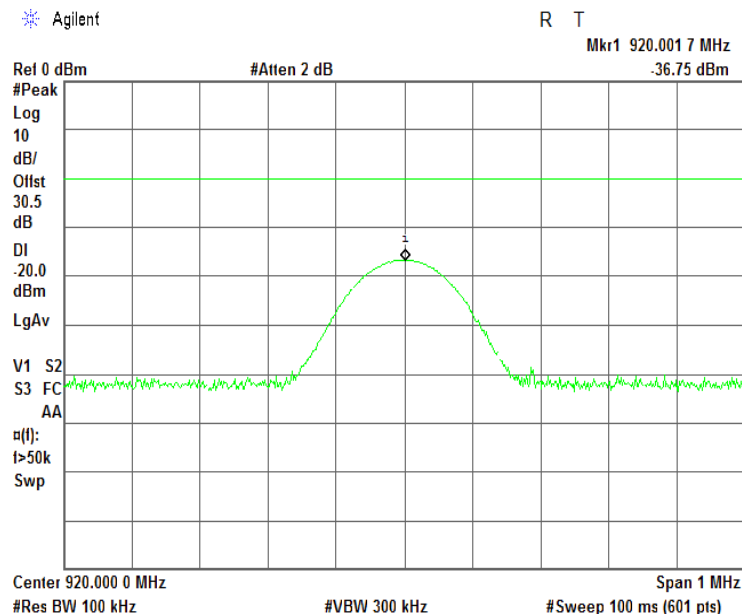


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.19 Conducted spurious emission measurements at the 2nd harmonic of low carrier frequency

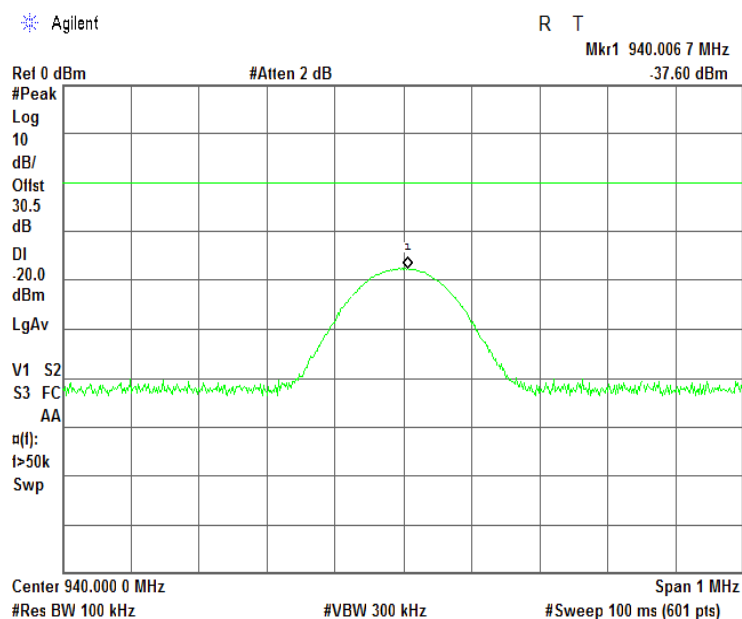


Plot 7.9.20 Conducted spurious emission measurements at the 2nd harmonic of mid carrier frequency

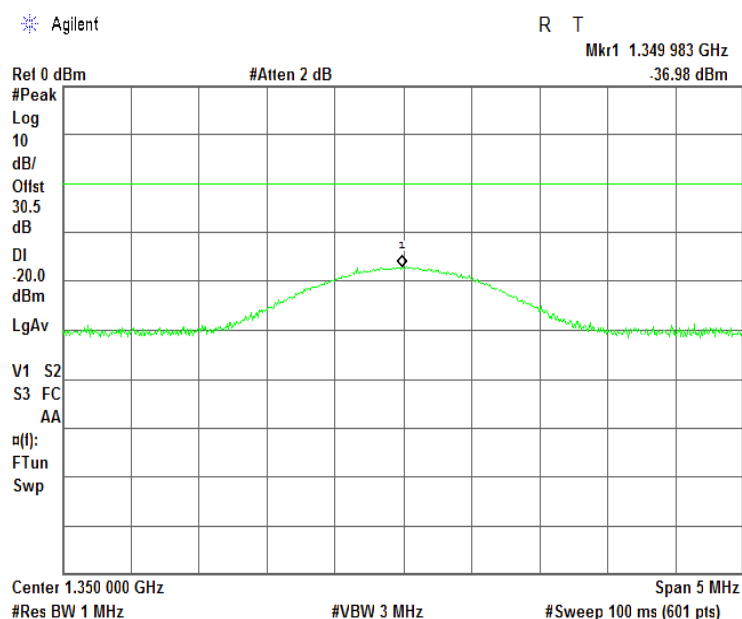


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.21 Conducted spurious emission measurements at the 2nd harmonic of high carrier frequency

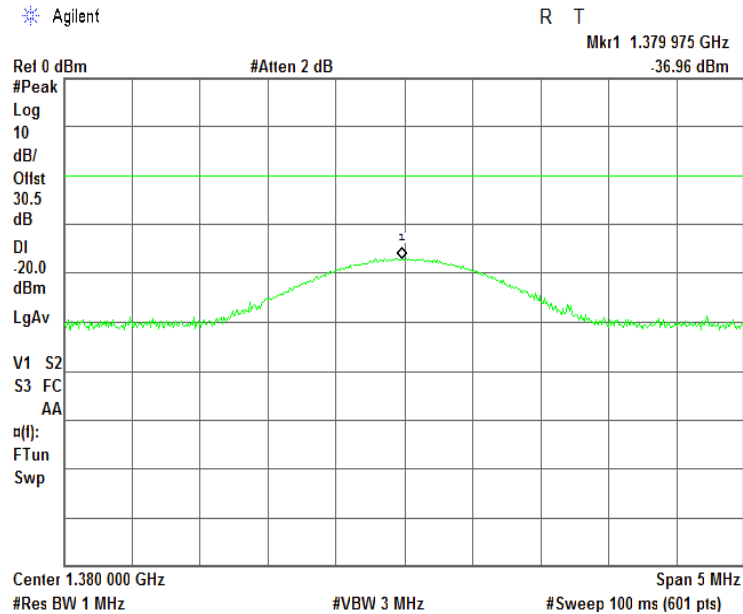


Plot 7.9.22 Conducted spurious emission measurements at the 3rd harmonic of low carrier frequency

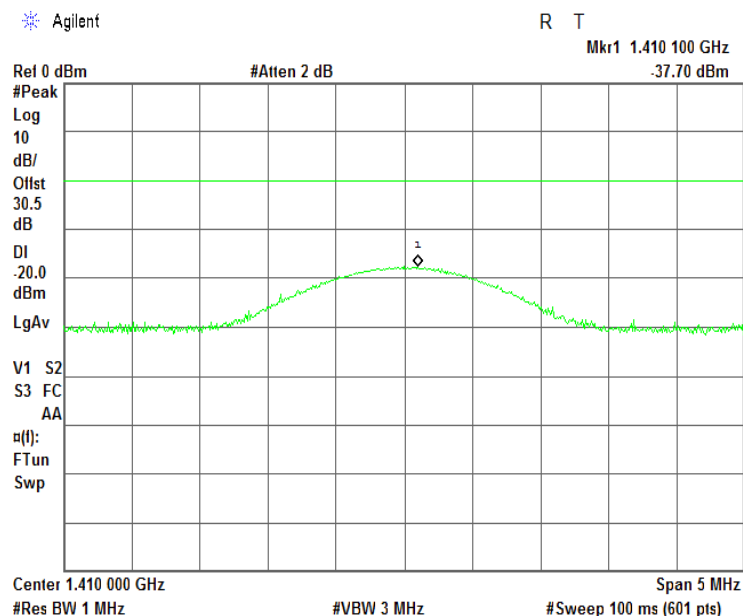


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.23 Conducted spurious emission measurements at the 3rd harmonic of mid carrier frequency

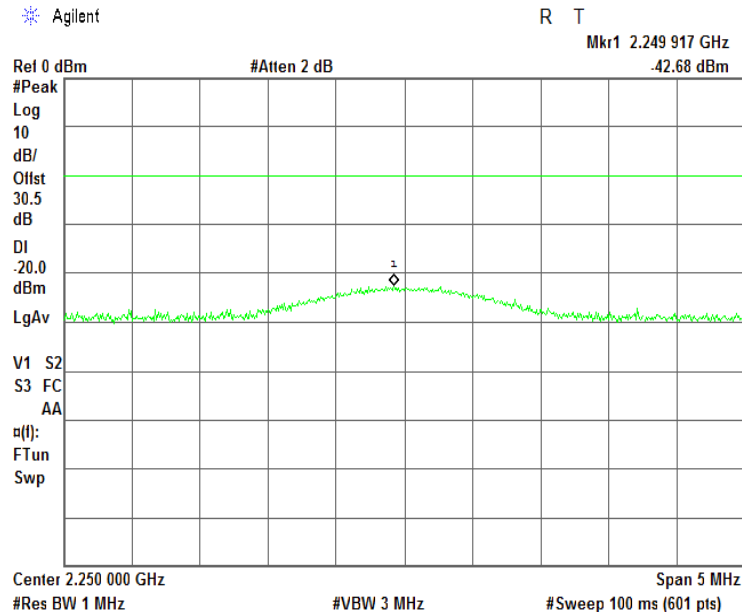


Plot 7.9.24 Conducted spurious emission measurements at the 3rd harmonic of high carrier frequency

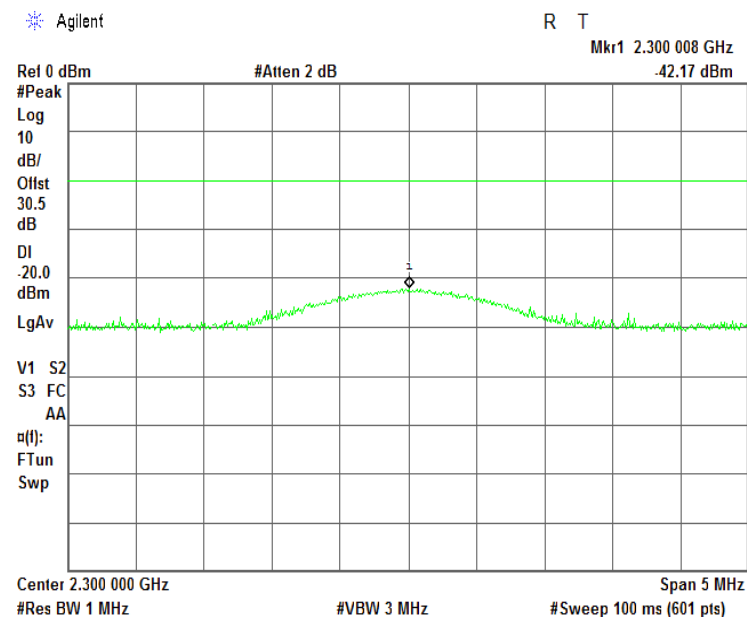


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.25 Conducted spurious emission measurements at the 5th harmonic of low carrier frequency

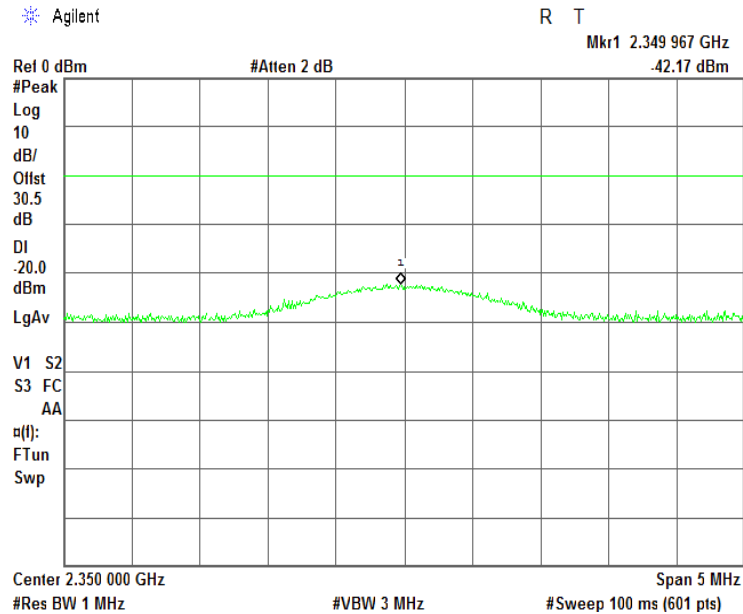


Plot 7.9.26 Conducted spurious emission measurements at the 5th harmonic of mid carrier frequency

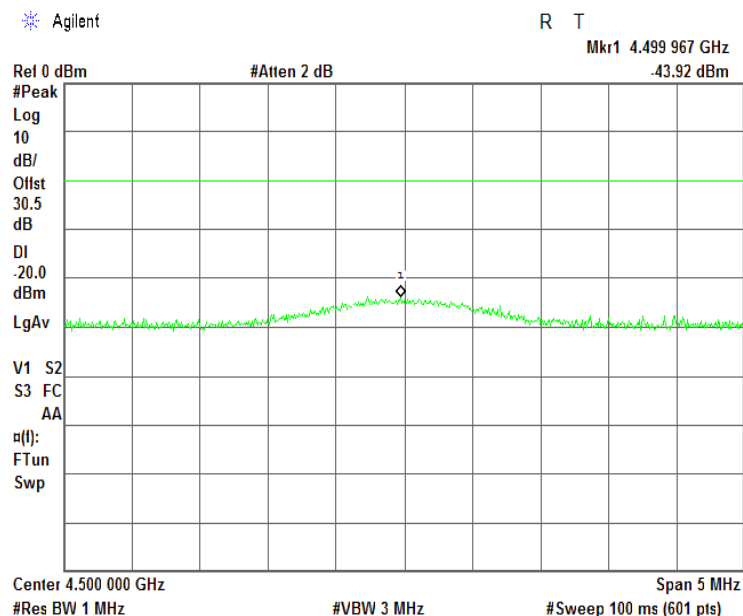


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.27 Conducted spurious emission measurements at the 5th harmonic of high carrier frequency

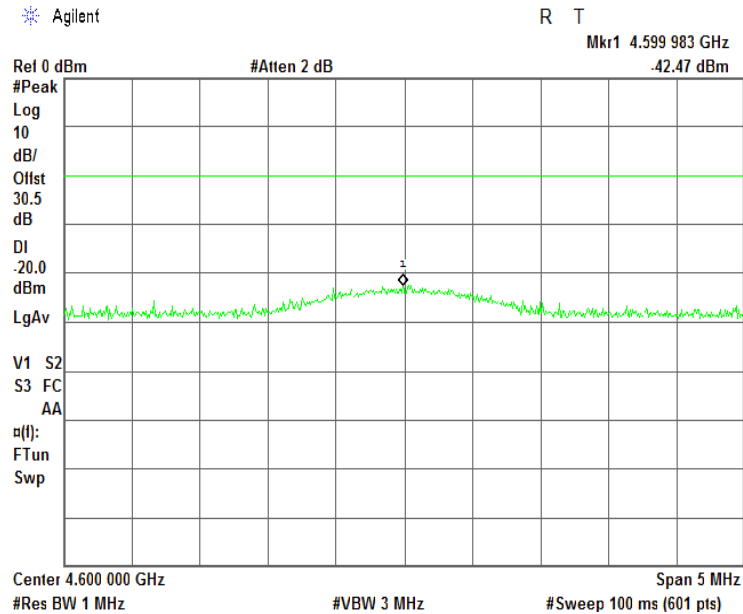


Plot 7.9.28 Conducted spurious emission measurements at the 10th harmonic of low carrier frequency

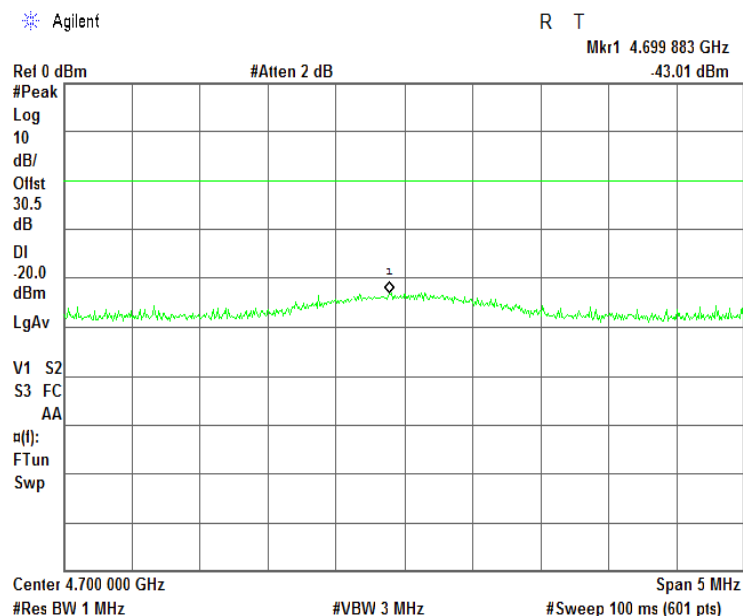


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.9.29 Conducted spurious emission measurements at the 10th harmonic of mid carrier frequency



Plot 7.9.30 Conducted spurious emission measurements at the 10th harmonic of high carrier frequency



Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

7.10 Spurious emissions at RF antenna connector test for 25 kHz CBW

7.10.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.10.1.

Table 7.10.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm
0.009 – 10th harmonic*	43+10logP** (mask C)	-13.0

* - spurious emission limits do not apply to the in band emission within ± 250 % of the authorized bandwidth from the carrier; investigated in course of emission mask testing

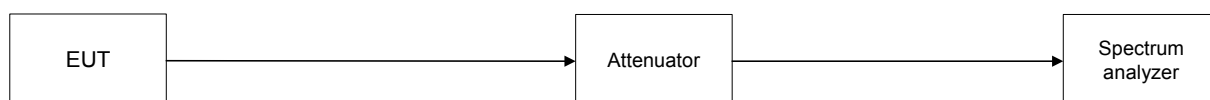
7.10.2 ** - P is transmitter output power in Watts Test procedure

7.10.2.1 The EUT was set up as shown in Figure 7.10.1, energized and its proper operation was checked.

7.10.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.10.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.10.2 and associated plots.

Figure 7.10.1 Spurious emission test setup





Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Table 7.10.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 450-470 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 MODULATION: GFSK
 BIT RATE: 11 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
900.00	-40.71	included	included	120	-40.71	-13	-27.71	Pass
1349.98	-37.37	included	included	1000	-37.37	-13	-24.37	Pass
2249.98	-42.24	included	included	1000	-42.24	-13	-29.24	Pass
4050.17	-43.08	included	included	1000	-43.08	-13	-30.08	Pass
Mid carrier frequency								
919.99	-41.96	included	included	120	-41.96	-13	-28.96	Pass
1379.98	-37.29	included	included	1000	-37.29	-13	-24.29	Pass
2299.95	-42.21	included	included	1000	-42.21	-13	-29.21	Pass
4139.77	-45.01	included	included	1000	-45.01	-13	-32.01	Pass
High carrier frequency								
940.00	-44.03	included	included	120	-44.03	-13	-31.03	Pass
1410.03	-38.31	included	included	1000	-38.31	-13	-25.31	Pass
2349.95	-42.51	included	included	1000	-42.51	-13	-29.51	Pass
4229.78	-43.23	included	included	1000	-43.23	-13	-30.23	Pass

*- Margin = Spurious emission – specification limit.

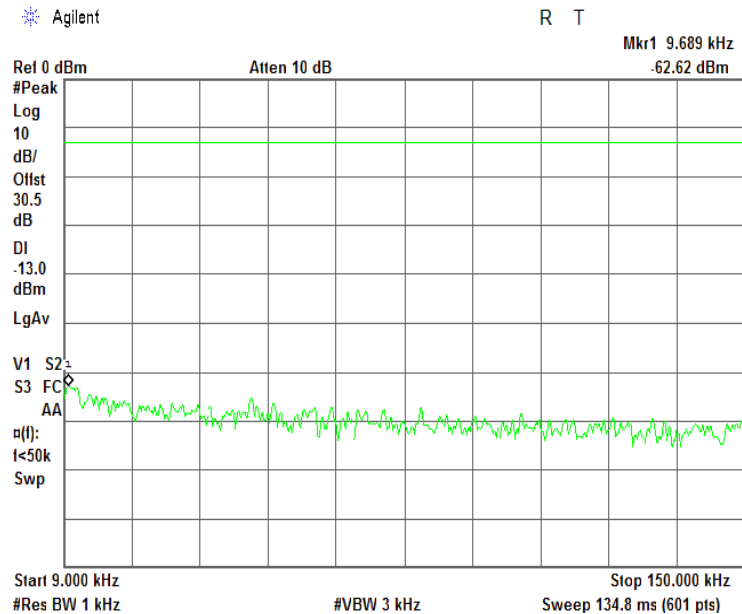
Reference numbers of test equipment used

HL 3433	HL 3818	HL 4068					
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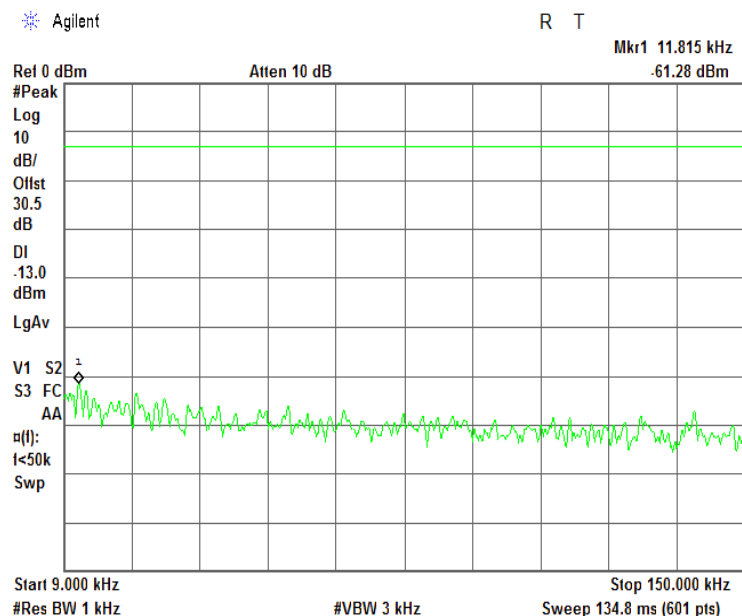
Full description is given in Appendix A.

Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

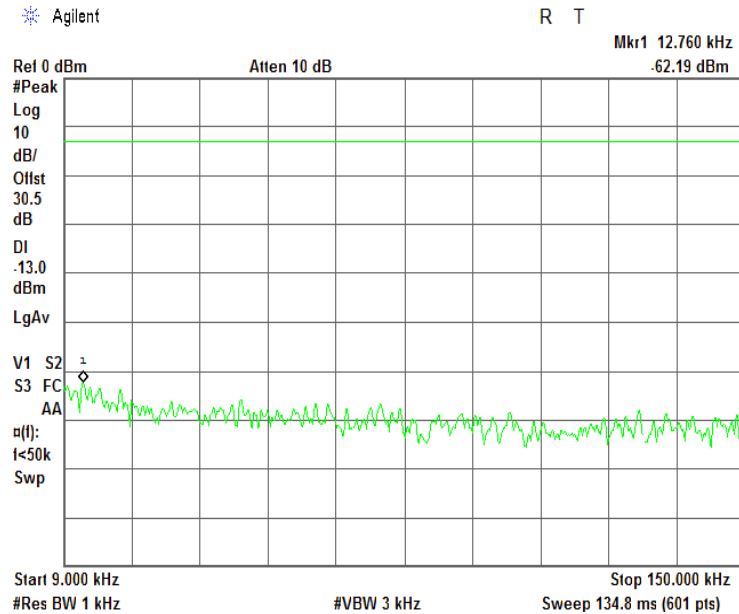


Plot 7.10.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency

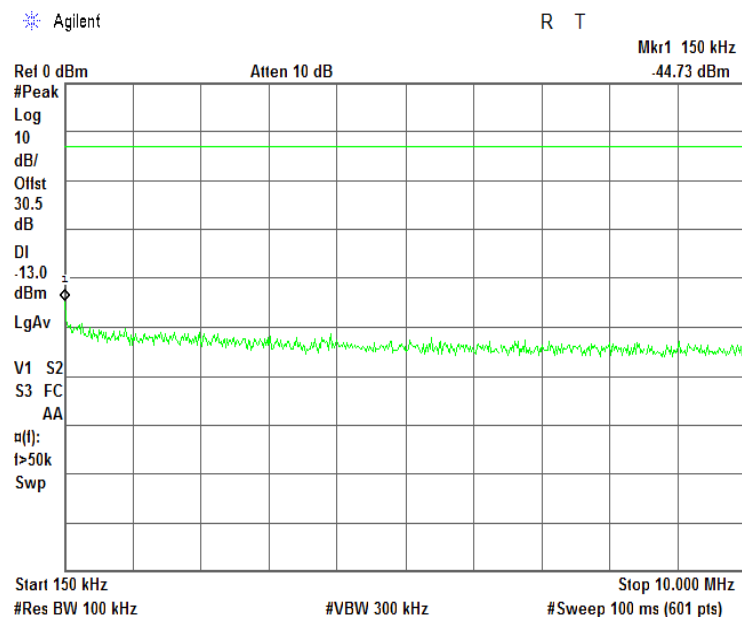


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.3 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency

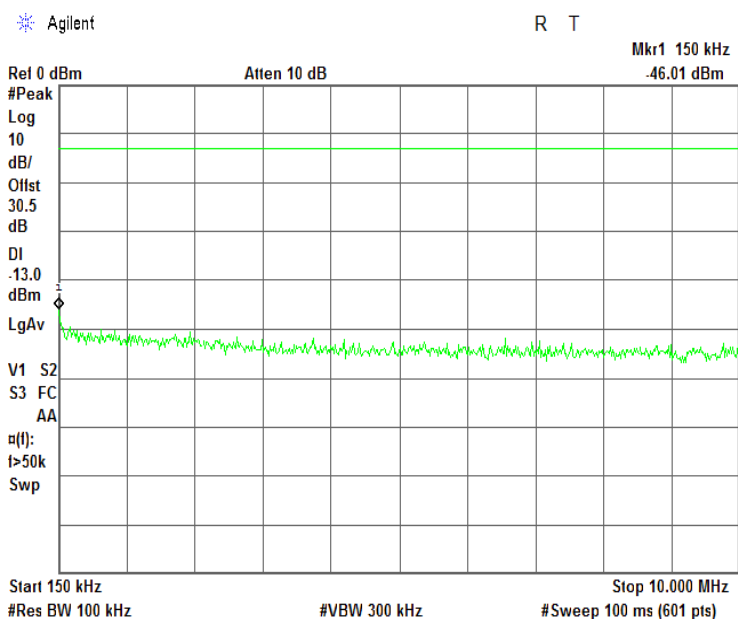


Plot 7.10.4 Spurious emission measurements in 0.15 - 10.0 MHz range at low carrier frequency

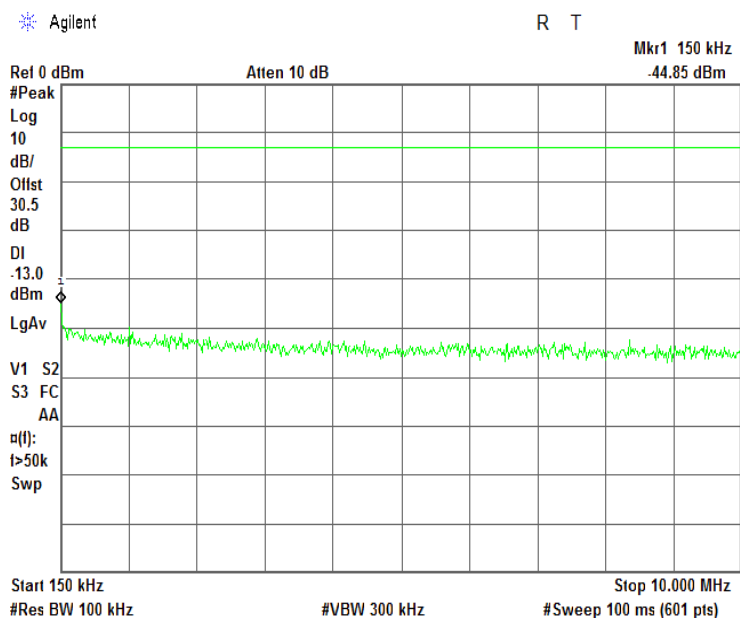


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.5 Spurious emission measurements in 0.15 - 10.0 MHz range at mid carrier frequency

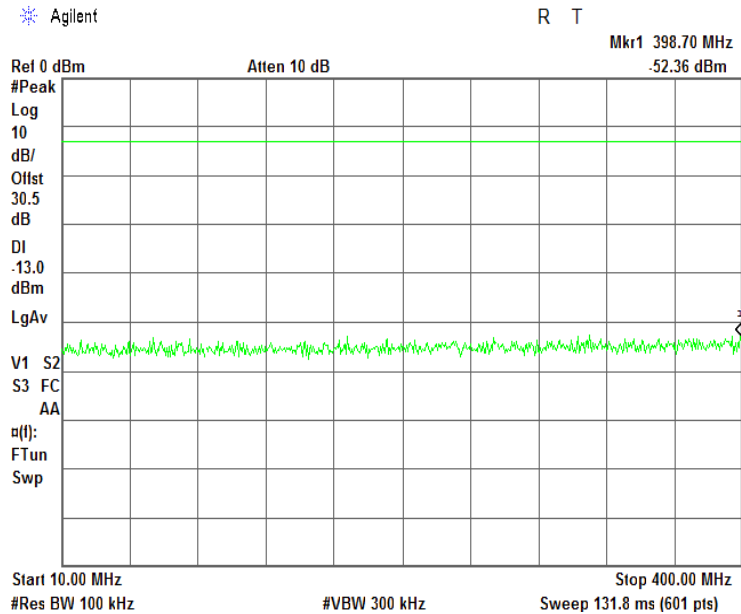


Plot 7.10.6 Spurious emission measurements in 0.15 - 10.0 MHz range at high carrier frequency

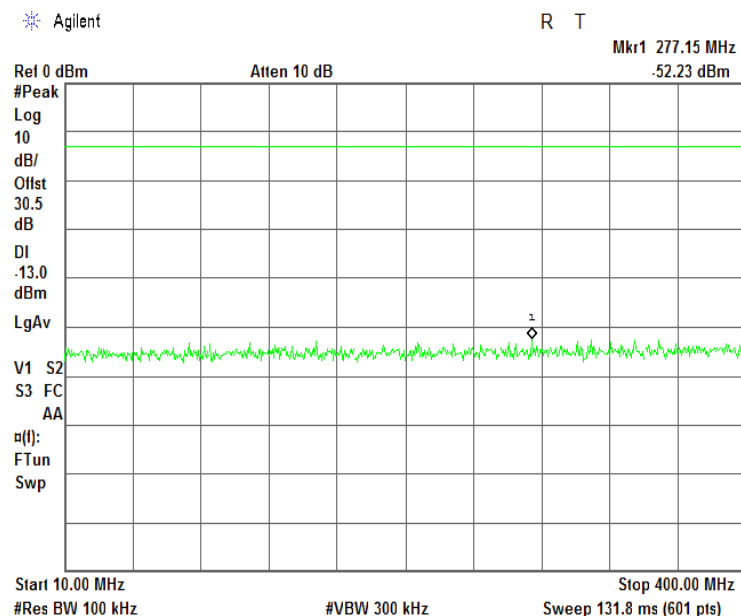


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.7 Spurious emission measurements in 10 - 400 MHz range at low carrier frequency

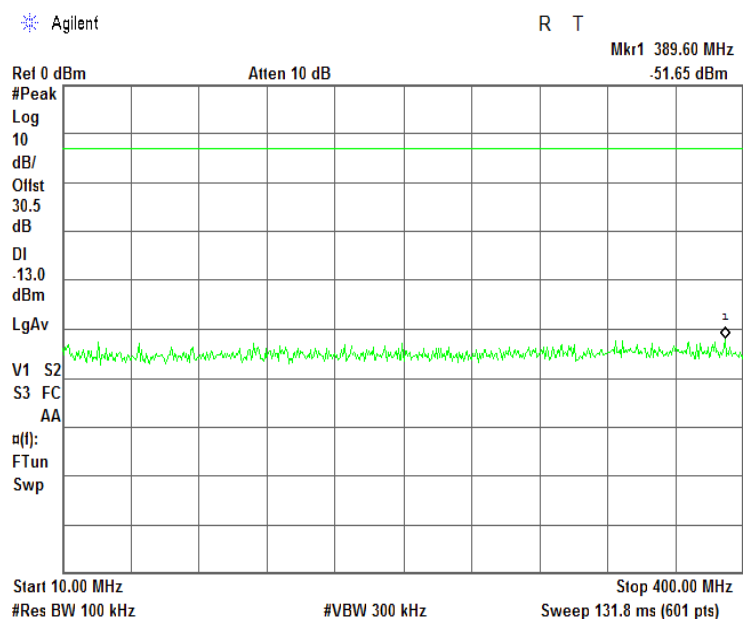


Plot 7.10.8 Spurious emission measurements in 10 - 400 MHz range at mid carrier frequency

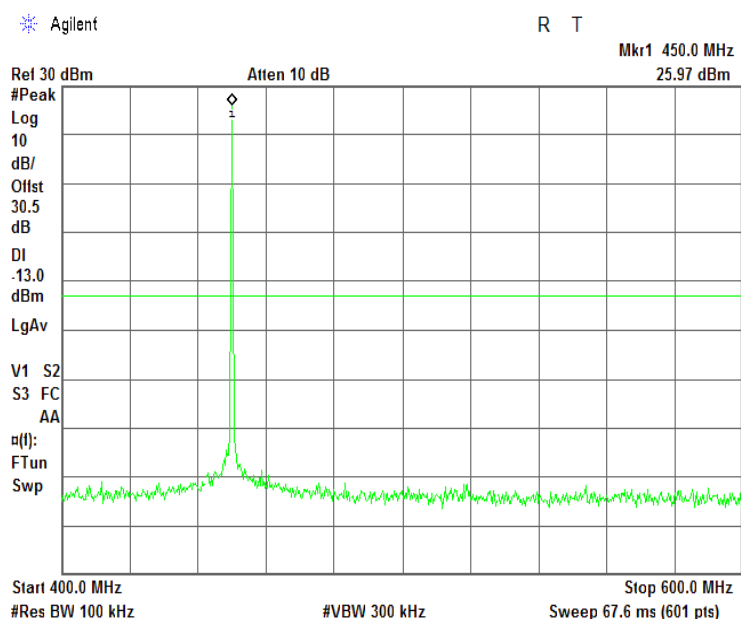


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.9 Spurious emission measurements in 10 - 400 MHz range at high carrier frequency

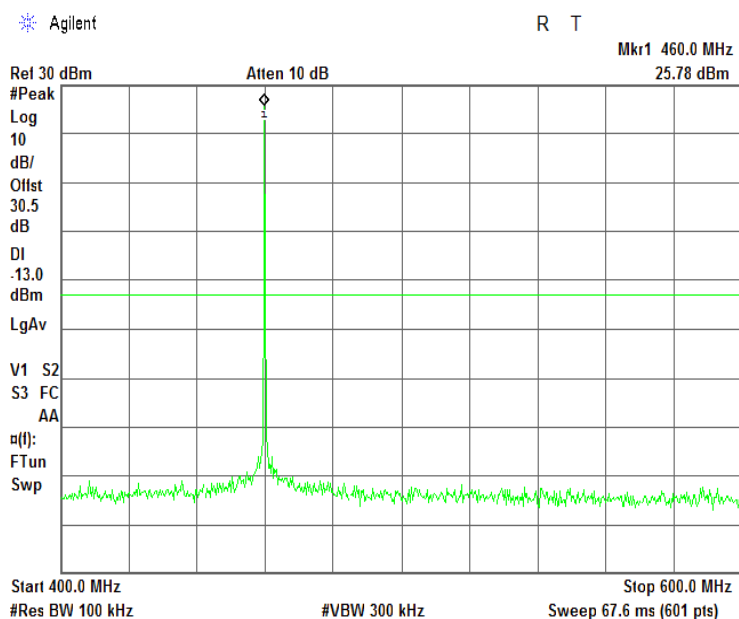


Plot 7.10.10 Spurious emission measurements in 400 - 600 MHz range at low carrier frequency

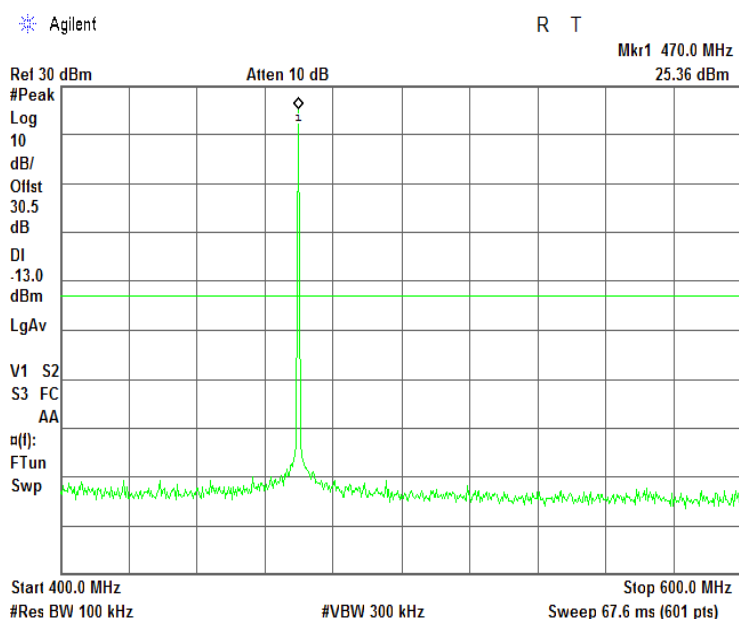


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.11 Spurious emission measurements in 400 - 600 MHz range at mid carrier frequency

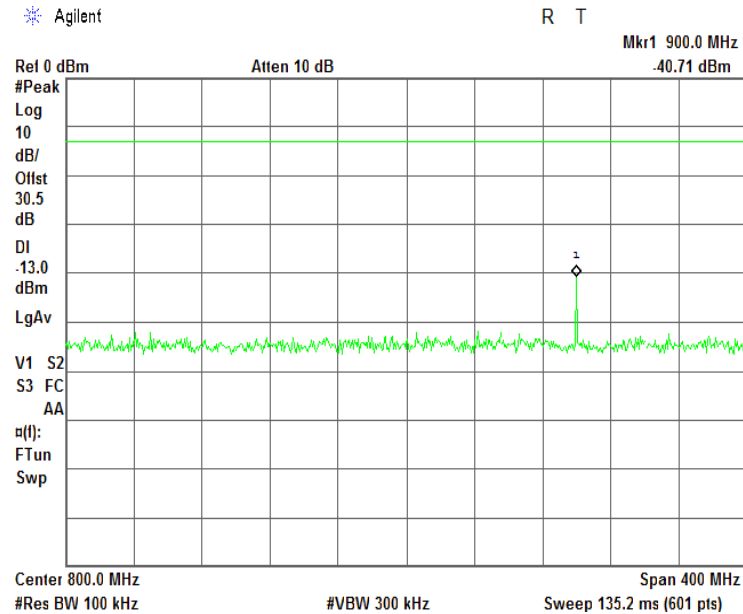


Plot 7.10.12 Spurious emission measurements in 400 - 600 MHz range at high carrier frequency

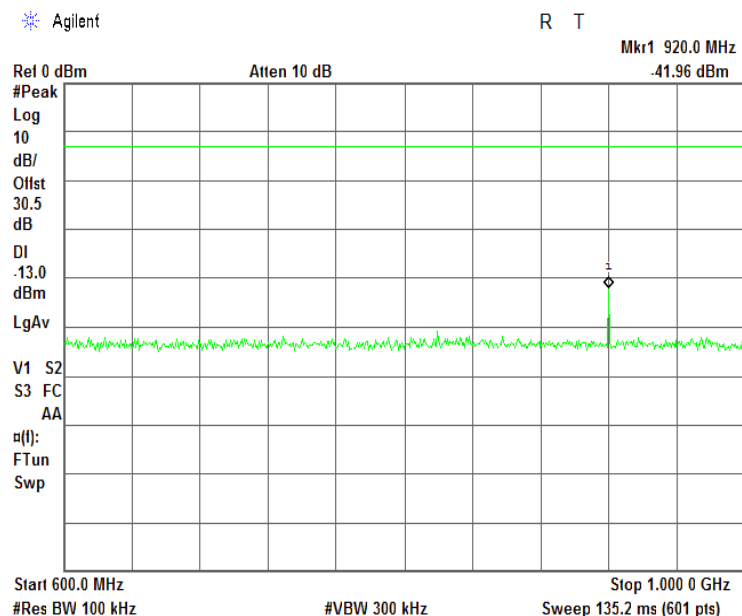


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.13 Spurious emission measurements in 600 - 1000 MHz range at low carrier frequency

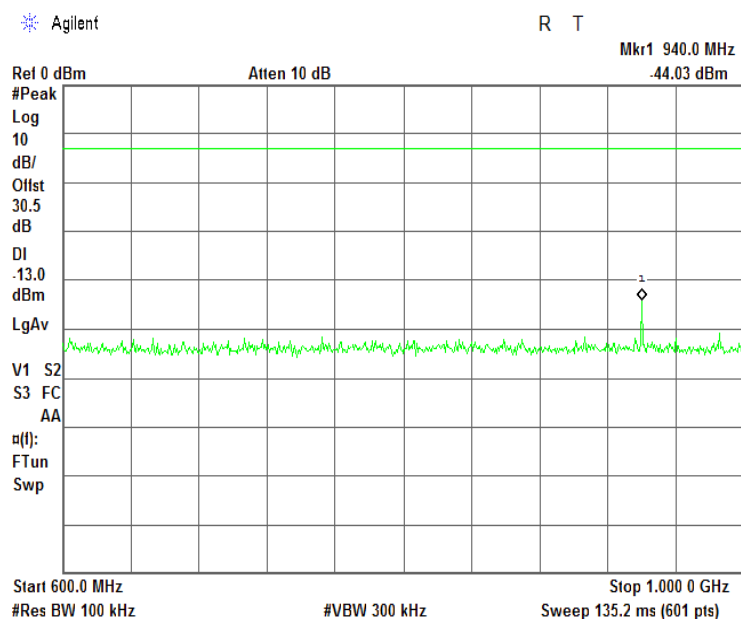


Plot 7.10.14 Spurious emission measurements in 600 - 1000 MHz range at mid carrier frequency

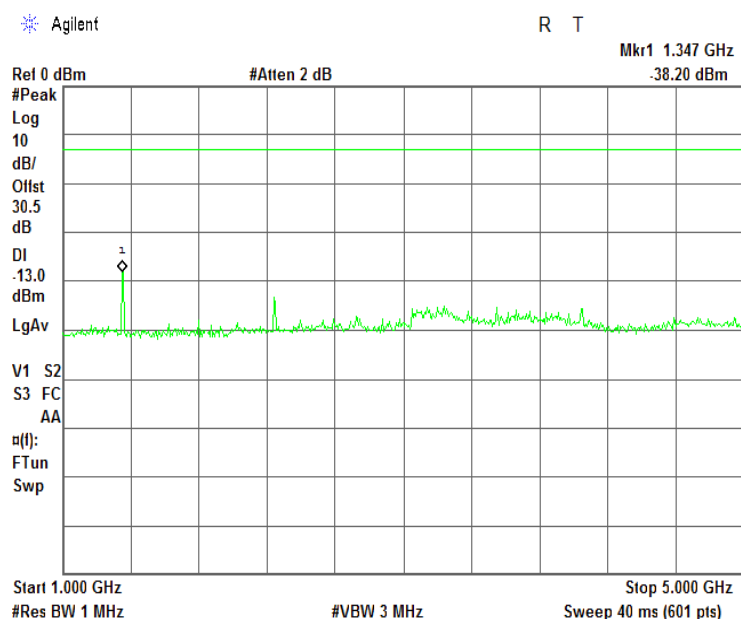


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.15 Spurious emission measurements in 600 - 1000 MHz range at high carrier frequency

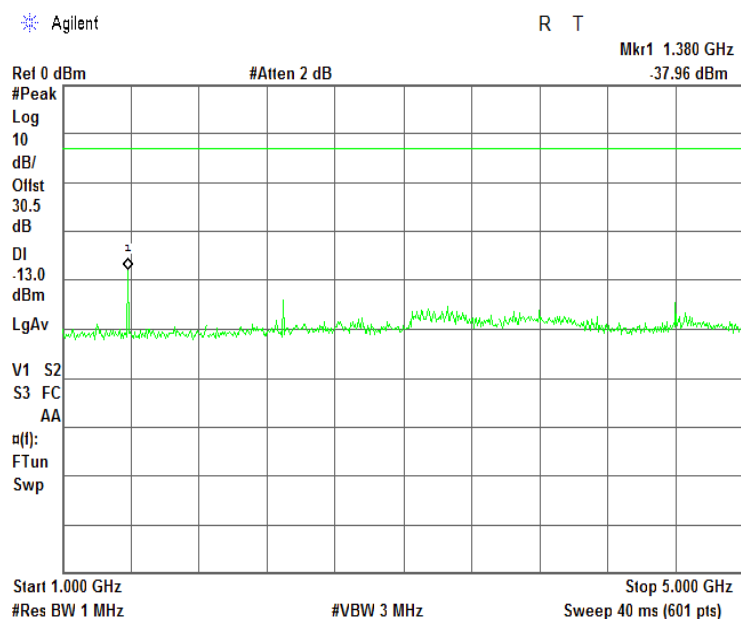


Plot 7.10.16 Spurious emission measurements in 1000 - 5000 MHz range at low carrier frequency

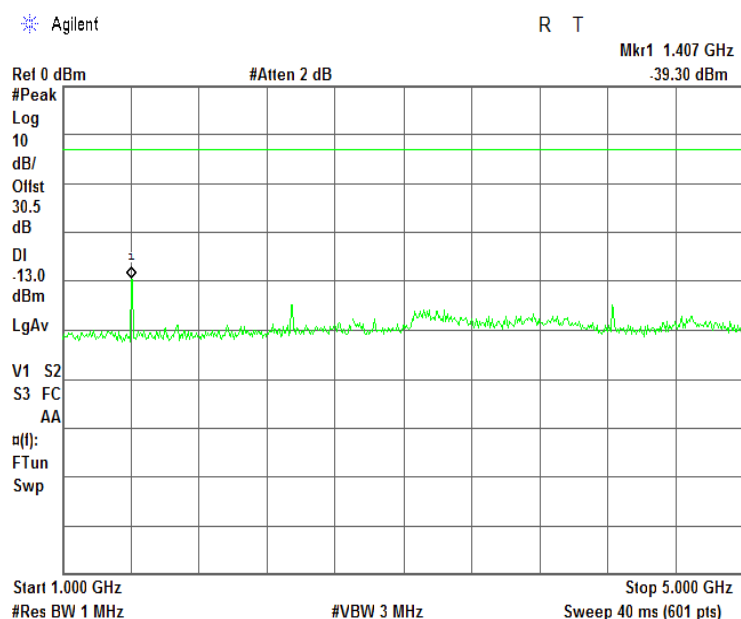


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.17 Spurious emission measurements in 1000 - 5000 MHz range at mid carrier frequency

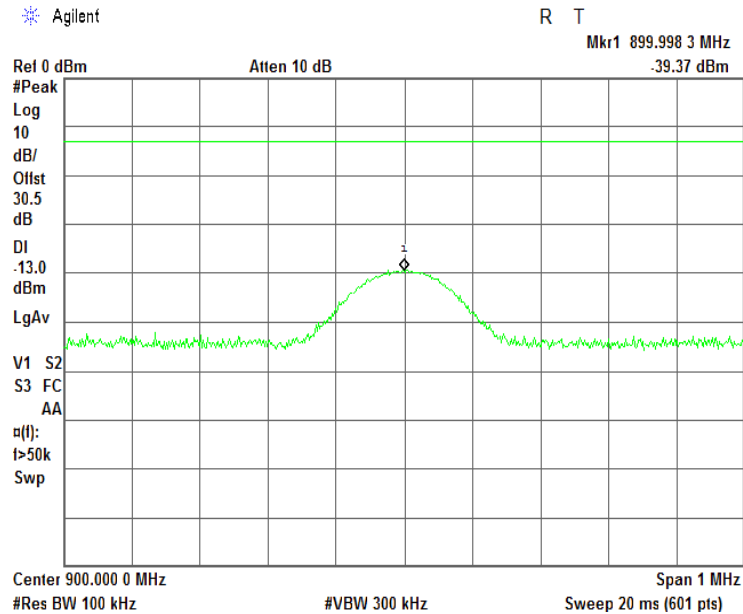


Plot 7.10.18 Spurious emission measurements in 1000 - 5000 MHz range at high carrier frequency

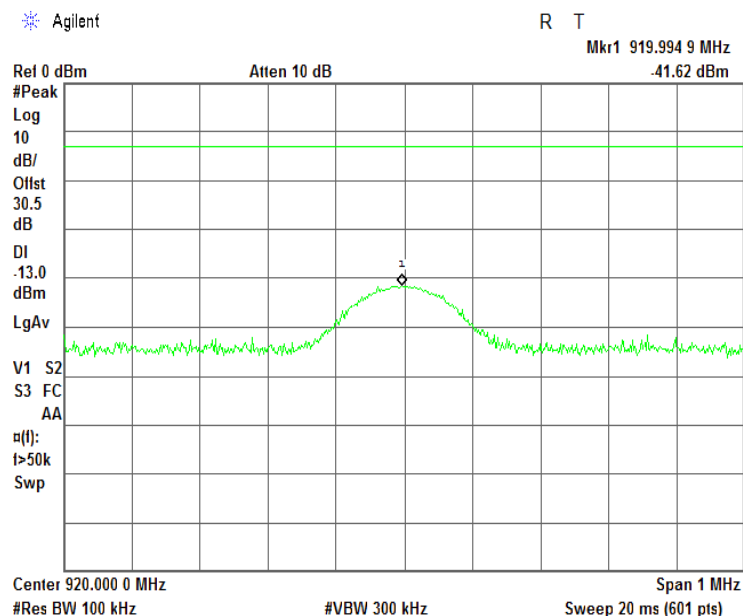


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.19 Conducted spurious emission measurements at the 2nd harmonic of low carrier frequency

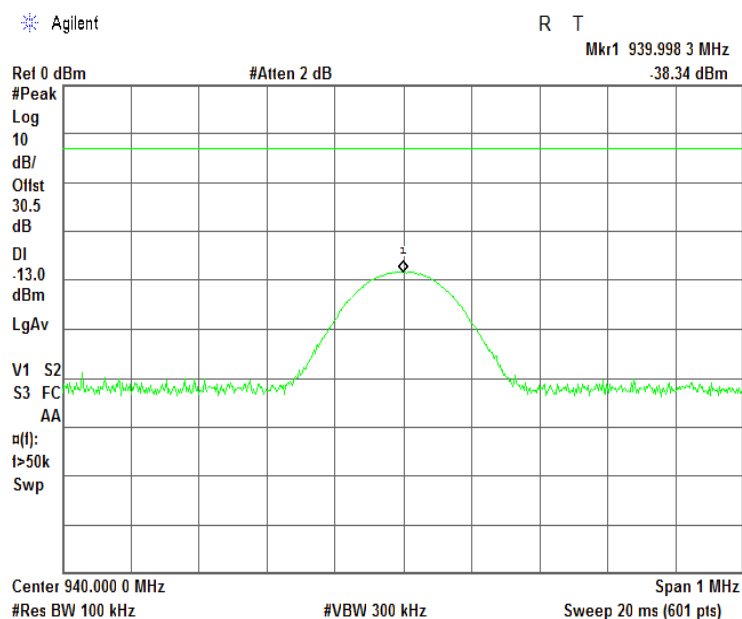


Plot 7.10.20 Conducted spurious emission measurements at the 2nd harmonic of mid carrier frequency

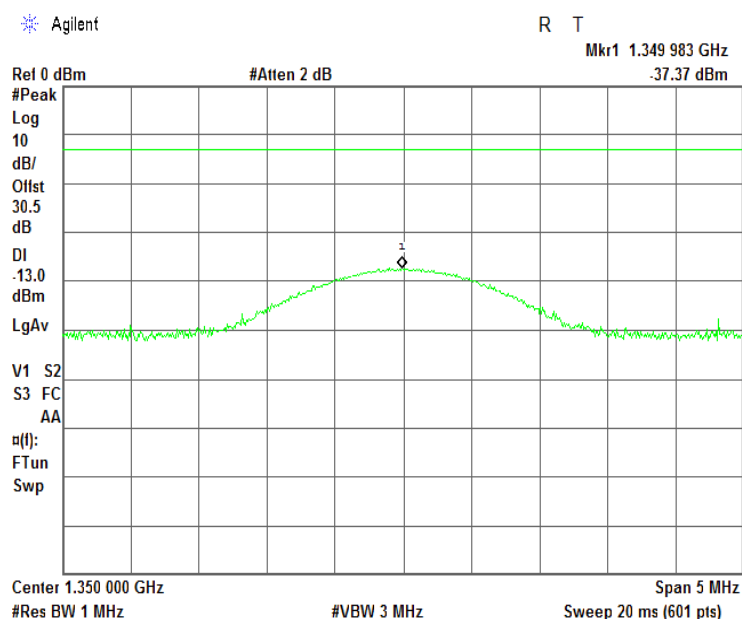


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.21 Conducted spurious emission measurements at the 2nd harmonic of high carrier frequency

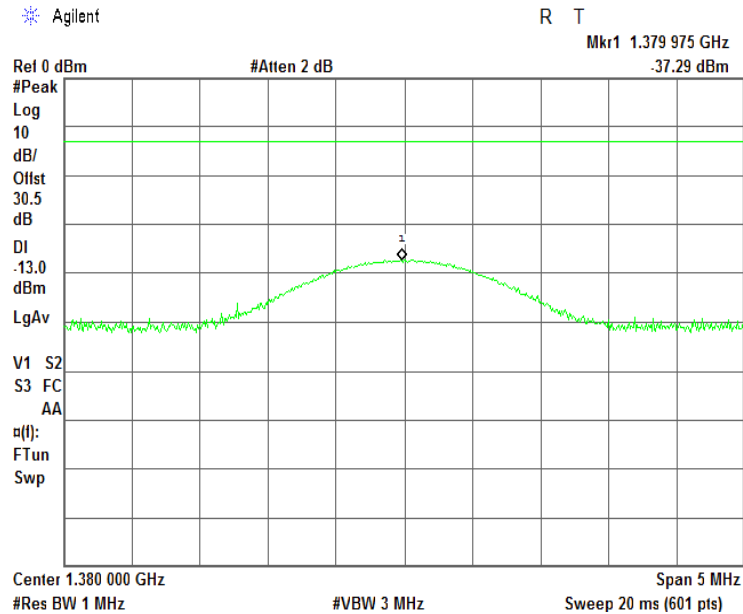


Plot 7.10.22 Conducted spurious emission measurements at the 3rd harmonic of low carrier frequency

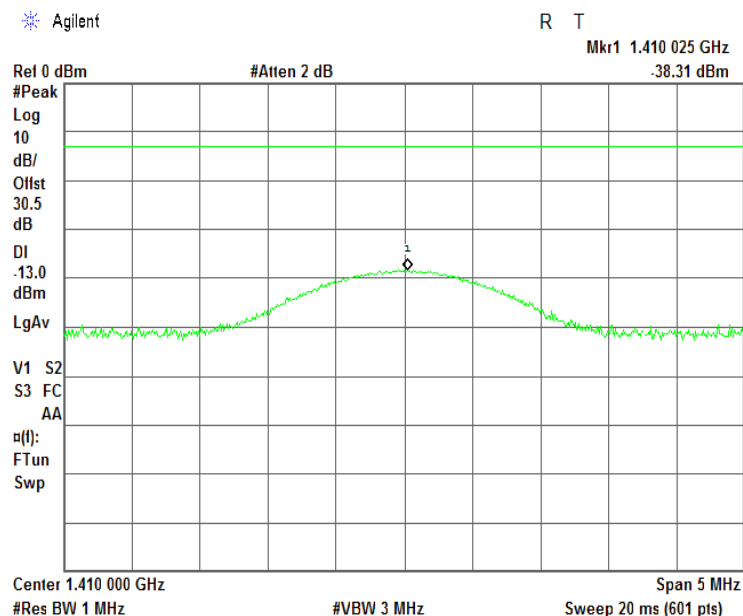


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.23 Conducted spurious emission measurements at the 3rd harmonic of mid carrier frequency

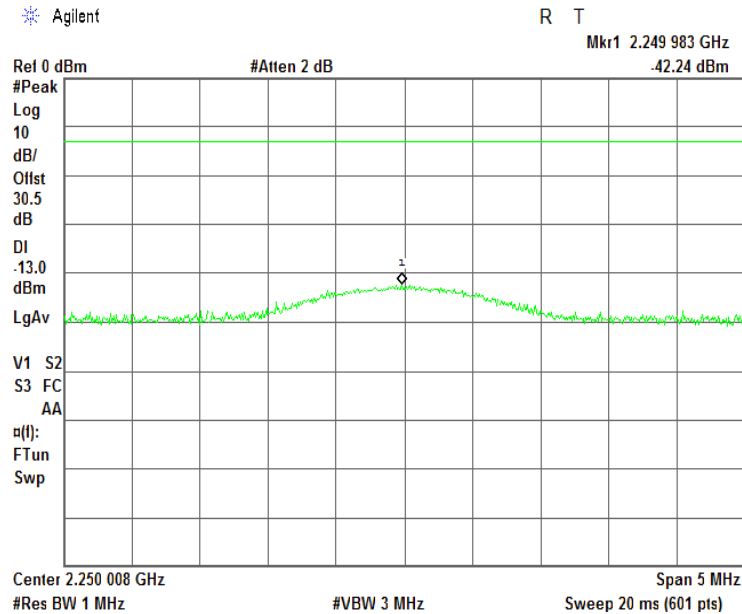


Plot 7.10.24 Conducted spurious emission measurements at the 3rd harmonic of high carrier frequency

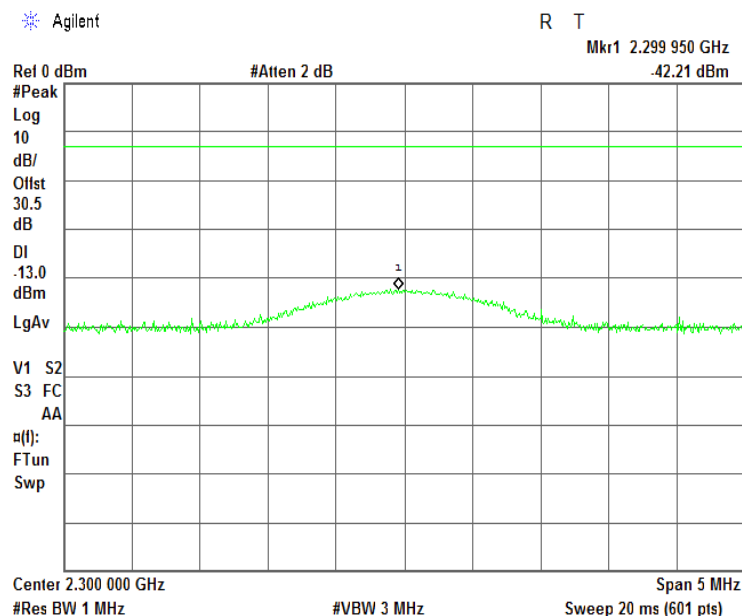


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.25 Conducted spurious emission measurements at the 5th harmonic of low carrier frequency

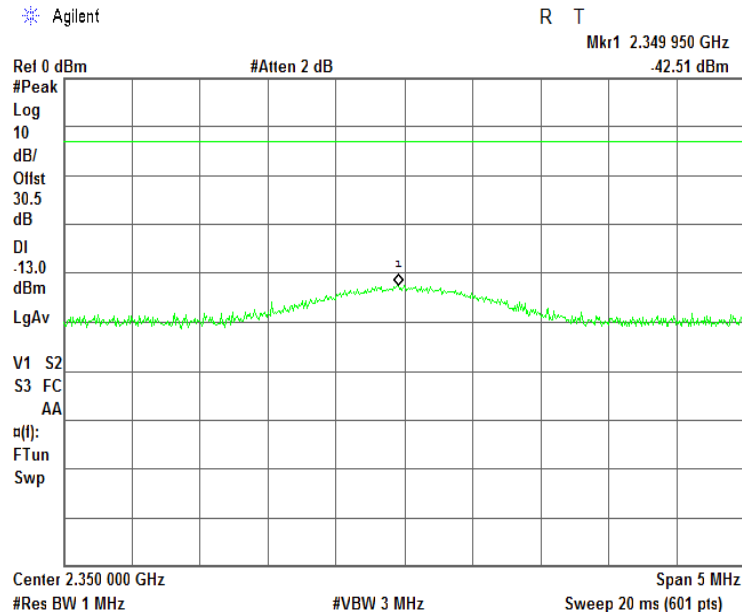


Plot 7.10.26 Conducted spurious emission measurements at the 5th harmonic of mid carrier frequency

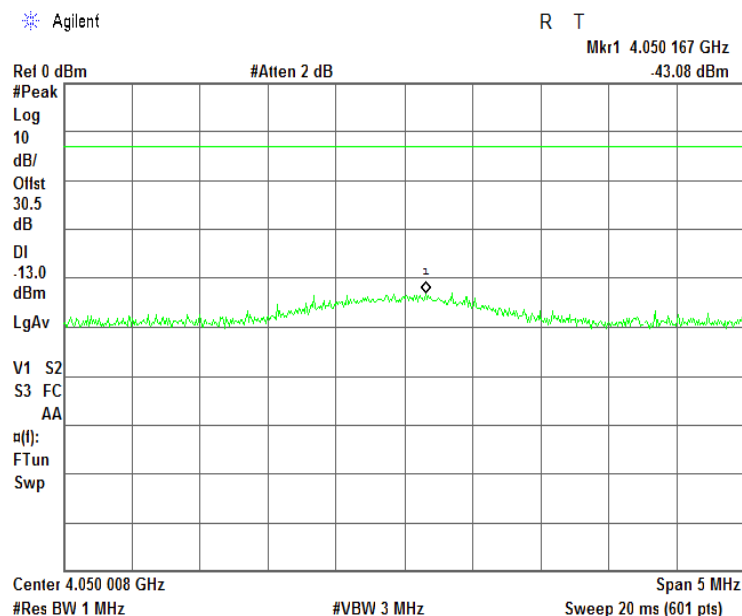


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.27 Conducted spurious emission measurements at the 5th harmonic of high carrier frequency

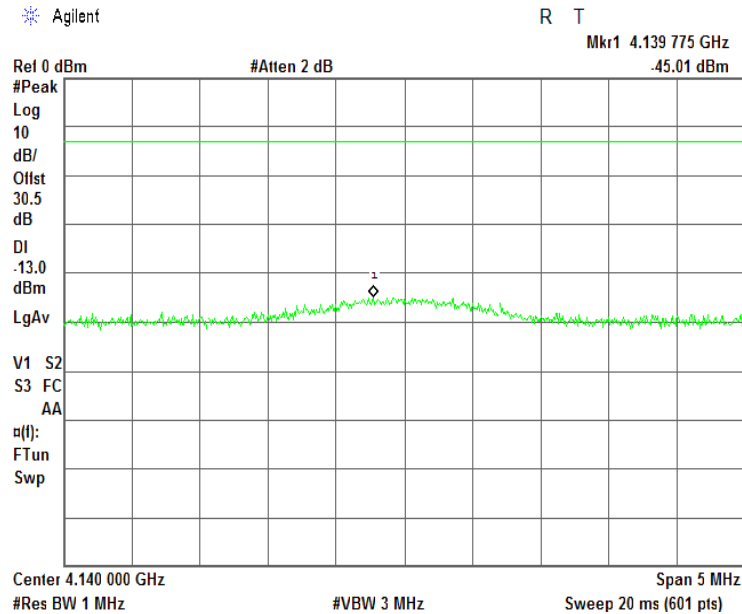


Plot 7.10.28 Conducted spurious emission measurements at the 9th harmonic of low carrier frequency

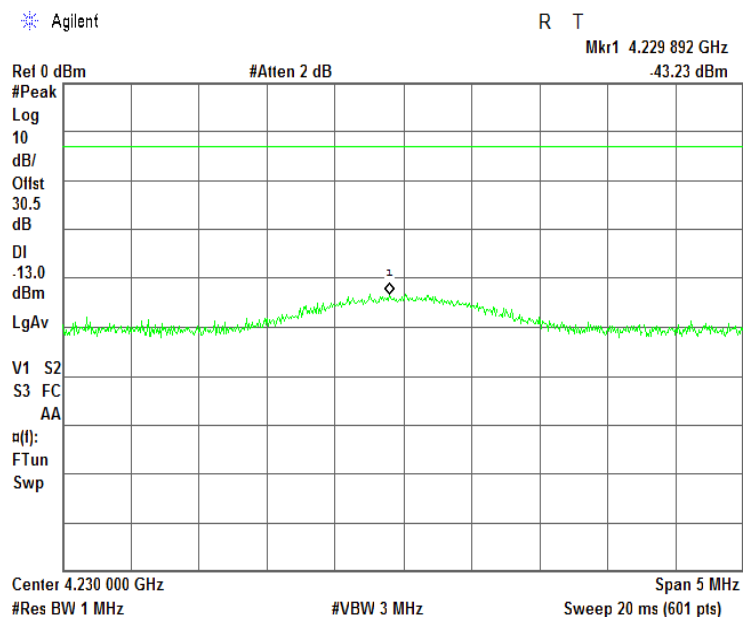


Test specification:		Section 90.210, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(d); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.10.29 Conducted spurious emission measurements at the 9th harmonic of mid carrier frequency



Plot 7.10.30 Conducted spurious emission measurements at the 9th harmonic of high carrier frequency



Test specification:		Section 90.213, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		13-Jan-16	
Temperature: 23 °C	Air Pressure: 1008 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks:			

7.11 Frequency stability test

7.11.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.11.1.

Table 7.11.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450	1.5	675
460		690
470		705

7.11.2 Test procedure

7.11.2.1 The EUT was set up as shown in Figure 7.11.1, energized and its proper operation was checked.

7.11.2.2 The EUT power was turned off. Temperature within test chamber was set to +30°C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

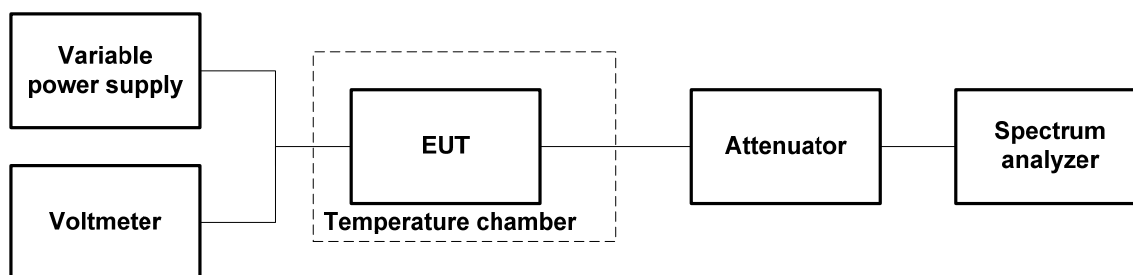
7.11.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

7.11.2.4 The above procedure was repeated at 0°C and at the lowest test temperature.

7.11.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.

7.11.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.11.2.

Figure 7.11.1 Frequency stability test setup



Test specification:	Section 90.213, Frequency stability				
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2				
Test mode:	Compliance	Verdict:			PASS
Date(s):	13-Jan-16				
Temperature: 23 °C	Air Pressure: 1008 hPa	Relative Humidity: 56 %	Power Supply: Battery		
Remarks:					

Table 7.11.2 Frequency stability test results

OPERATING FREQUENCY RANGE: 450-470 MHz
 NOMINAL POWER VOLTAGE: 12 V
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 100 Hz
 VIDEO BANDWIDTH: 300 Hz
 MODULATION: Unmodulated

MODULATION: _____													
Unmodulated _____													
T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1 st min	2 nd min	3 rd min	4 th min	5 th min	10 th min	Positive	Negative			
Low frequency													
-30	nominal	449.999197	449.999197	449.999200	449.999200	449.999207	449.999208	449.999208	0	235	675	-440	Pass
-20	nominal	449.999192	NA	NA	NA	NA	NA	449.999192	0	251		-424	Pass
-10	nominal	449.999383	NA	NA	NA	NA	NA	449.999300	0	143		-532	Pass
0	nominal	449.999350	449.999375	449.999375	449.999375	449.999381	449.999383	449.999383	0	60		-615	Pass
10	nominal	449.999417	NA	NA	NA	NA	NA	449.999425	0	18		-657	Pass
20	+15%	449.999437	NA	NA	NA	NA	NA	449.999443	0	0		-675	Pass
20	nominal	449.999440	NA	NA	NA	NA	NA	449.999443	0	0		-675	Pass
20	-15%	449.999443	NA	NA	NA	NA	NA	449.999443	0	0		-675	Pass
30	nominal	449.999437	449.999443	449.999440	449.999443	449.999433	449.999440	449.999440	0	7		-668	Pass
40	nominal	449.999423	NA	NA	NA	NA	NA	449.999433	0	0		-675	Pass
50	nominal	449.999443	NA	NA	NA	NA	NA	449.999447	4	0	-671	Pass	
60	nominal	449.999453	NA	NA	NA	NA	NA	449.999458	15	0	-660	Pass	
Mid frequency													
-30	nominal	459.999200	459.999200	459.999202	459.999208	459.999208	459.999208	459.999208	0	239	690	-451	Pass
-20	nominal	459.999192	NA	NA	NA	NA	NA	459.999192	0	255		-435	Pass
-10	nominal	459.999367	NA	NA	NA	NA	NA	459.999300	0	147		-543	Pass
0	nominal	459.999375	459.999375	459.999375	459.999392	459.999392	459.999392	459.999392	0	55		-635	Pass
10	nominal	459.999425	NA	NA	NA	NA	NA	459.999433	0	14		-676	Pass
20	+15%	459.999450	NA	NA	NA	NA	NA	459.999450	3	0		-687	Pass
20	nominal	459.999440	NA	NA	NA	NA	NA	459.999447	0	0		-690	Pass
20	-15%	459.999450	NA	NA	NA	NA	NA	459.999450	3	0		-687	Pass
30	nominal	459.999443	459.999443	459.999440	459.999450	459.999443	459.999443	459.999437	0	10		-680	Pass
40	nominal	459.999440	NA	NA	NA	NA	NA	469.999453	6	0		-684	Pass
50	nominal	459.999453	NA	NA	NA	NA	NA	469.999457	10	0	-680	Pass	
60	nominal	459.999457	NA	NA	NA	NA	NA	459.999467	20	0	-670	Pass	
High frequency													
-30	nominal	469.999192	469.999192	469.999192	469.999192	469.999192	469.999200	469.999200	0	233	705	-472	Pass
-20	nominal	469.999150	NA	NA	NA	NA	NA	469.999150	0	283		-422	Pass
-10	nominal	469.999333	NA	NA	NA	NA	NA	469.999275	0	158		-547	Pass
0	nominal	469.999342	469.999342	469.999358	469.999358	469.999358	469.999363	469.999367	0	66		-639	Pass
10	nominal	469.999397	NA	NA	NA	NA	NA	469.999417	0	16		-689	Pass
20	+15%	469.999433	NA	NA	NA	NA	NA	469.999433	0	0		-705	Pass
20	nominal	469.999433	NA	NA	NA	NA	NA	469.999433	0	0		-705	Pass
20	-15%	469.999433	NA	NA	NA	NA	NA	469.999433	0	0		-705	Pass
30	nominal	469.999433	469.999430	469.999430	469.999430	469.999440	469.999433	469.999423	0	10		-695	Pass
40	nominal	469.999427	NA	NA	NA	NA	NA	469.999430	0	3		-702	Pass
50	nominal	469.999467	NA	NA	NA	NA	NA	469.999473	40	0	-665	Pass	
60	nominal	469.999443	NA	NA	NA	NA	NA	469.999467	34	0	-671	Pass	

* - Reference frequency

Reference numbers of test equipment used

HL 1424	HL 3210	HL 3310					
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Full description is given in Appendix A.



Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

7.12 Transient frequency behaviour test for 12.5 kHz CBW

7.12.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 7.12.1.

Table 7.12.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
421.0 – 512.0 MHz band			
12.5	± 12.5	10.0	t_1
	± 6.25	25.0	t_2
	± 12.5	10.0	t_3

* - t_{on} is the instant when a 1 kHz test signal is completely suppressed;

t_1 is the time period immediately following t_{on} ;

t_2 is the time period immediately following t_1 ;

t_3 is the time period from the instant when the transmitter is turned off until t_{off} ;

t_{off} is the instant when the 1 kHz test signal starts to rise.

7.12.2 Test procedure

7.12.2.1 The EUT was set up as shown in Figure 7.12.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

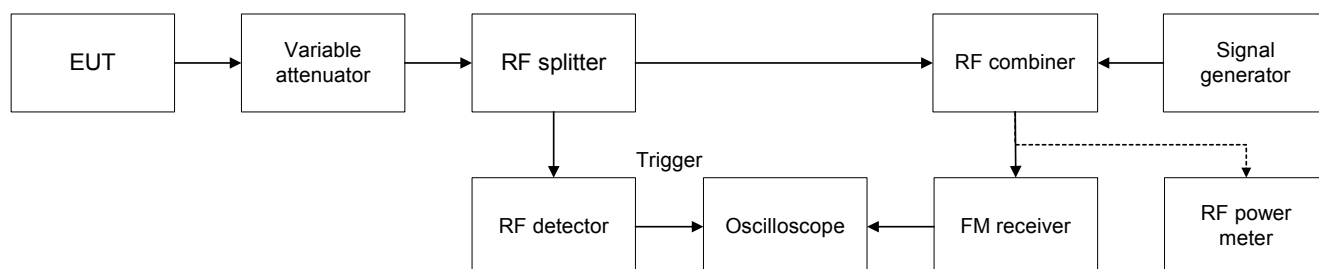
7.12.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

7.12.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

7.12.2.4 The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.

Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Figure 7.12.1 Transient frequency test setup





Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Table 7.12.2 Transient frequency behaviour test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 12.5 kHz						
450	t ₁	10.0	4	± 12.5	-8.5	Pass
	t ₂	25.0	0	± 6.25	-6.25	
	t ₃	10.0	0	± 12.5	-12.5	
460	t ₁	10.0	3	± 12.5	-9.5	Pass
	t ₂	25.0	0	± 6.25	-6.25	
	t ₃	10.0	0	± 12.5	-12.5	
470	t ₁	10.0	2	± 12.5	-10.5	Pass
	t ₂	25.0	0	± 6.25	-6.25	
	t ₃	10.0	0	± 12.5	-12.5	

Reference numbers of test equipment used

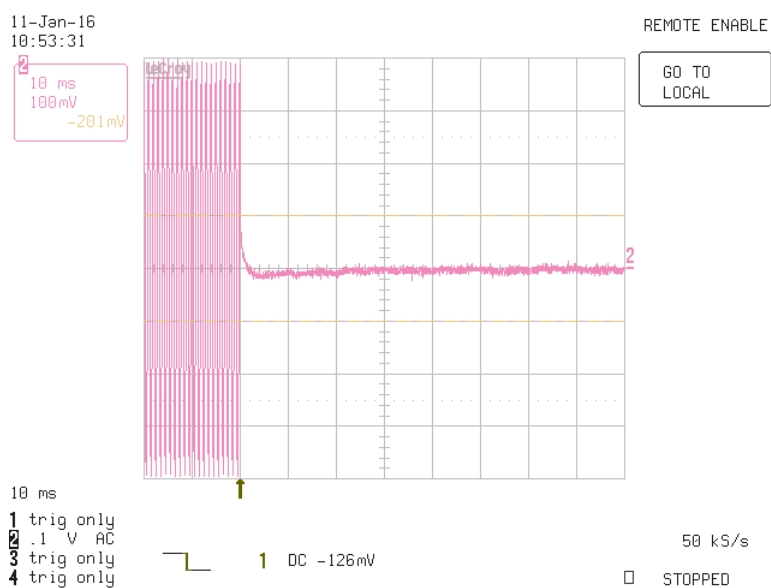
HL 0539	HL 0911	HL 2227	HL 3300	HL 3310	HL 3727	HL 4413	
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Full description is given in Appendix A.

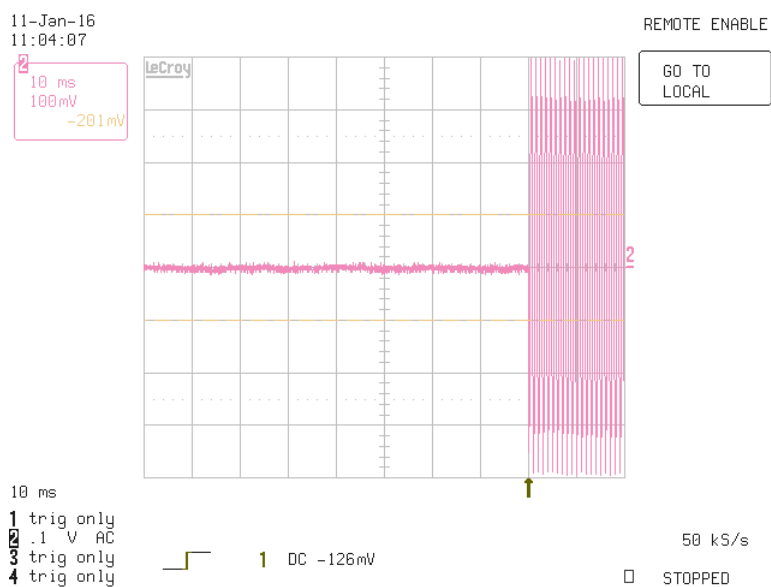
Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.12.1 Transient frequency during power ON test results at low carrier frequency

4 divisions vertically centered on the display=25 kHz deviation of the FM modulation
1 div=6.25 kHz

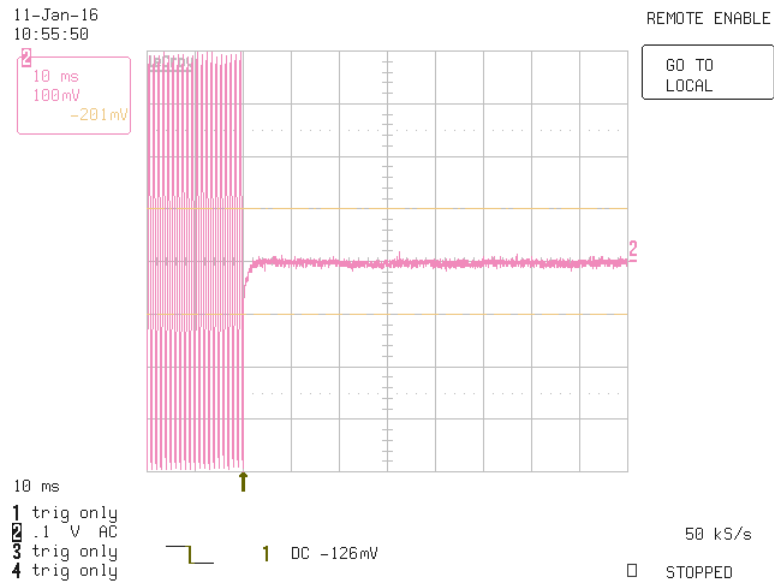


Plot 7.12.2 Transient frequency during power OFF test results at low carrier frequency

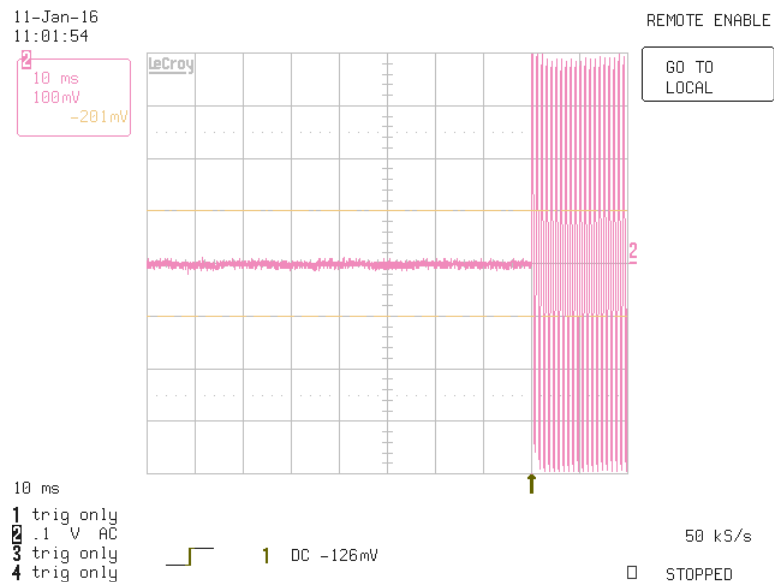


Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.12.3 Transient frequency during power ON test results at mid carrier frequency

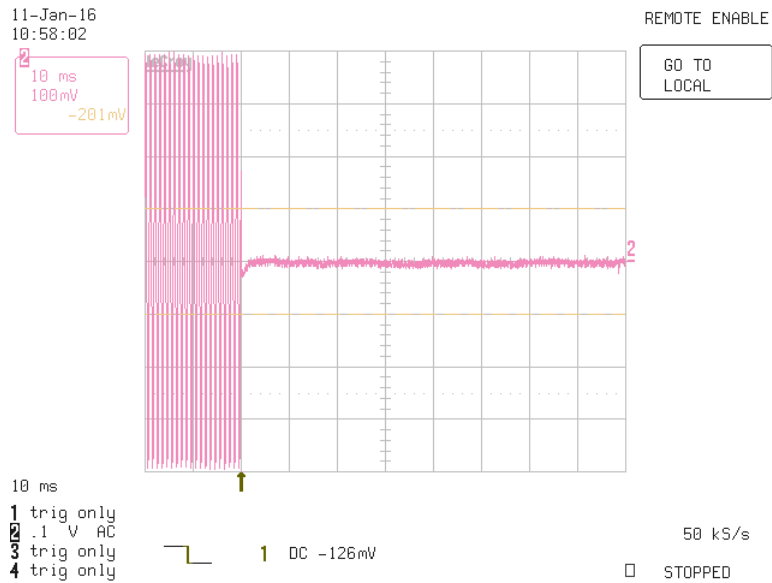


Plot 7.12.4 Transient frequency during power OFF test results at mid carrier frequency

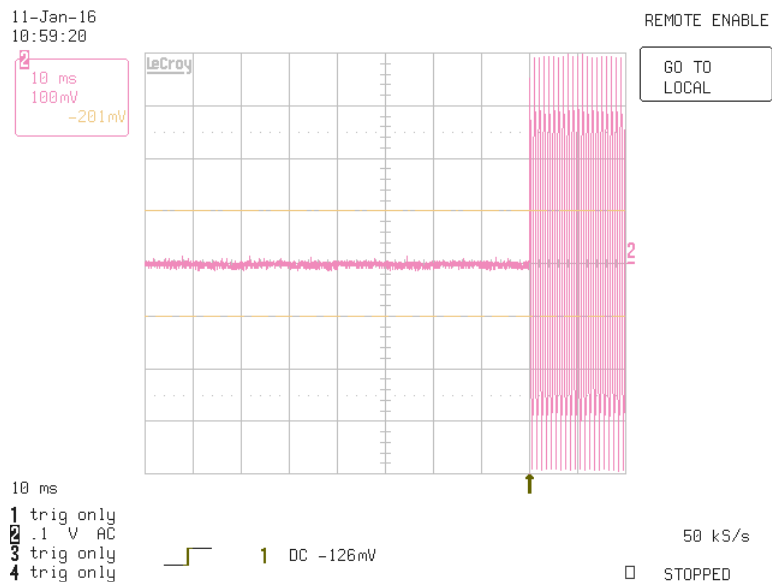


Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 12.5 kHz			

Plot 7.12.5 Transient frequency during power ON test results at high carrier frequency



Plot 7.12.6 Transient frequency during power OFF test results at high carrier frequency





Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

7.13 Transient frequency behaviour test for 25 kHz CBW

7.13.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 7.13.1.

Table 7.13.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
421.0 – 512.0 MHz band			
25.0	± 25.0	10.0	t ₁
	± 12.5	25.0	t ₂
	± 25.0	10.0	t ₃

* - t_{on} is the instant when a 1 kHz test signal is completely suppressed;

t₁ is the time period immediately following t_{on};

t₂ is the time period immediately following t₁;

t₃ is the time period from the instant when the transmitter is turned off until t_{off};

t_{off} is the instant when the 1 kHz test signal starts to rise.

7.13.2 Test procedure

7.13.2.1 The EUT was set up as shown in Figure 7.13.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

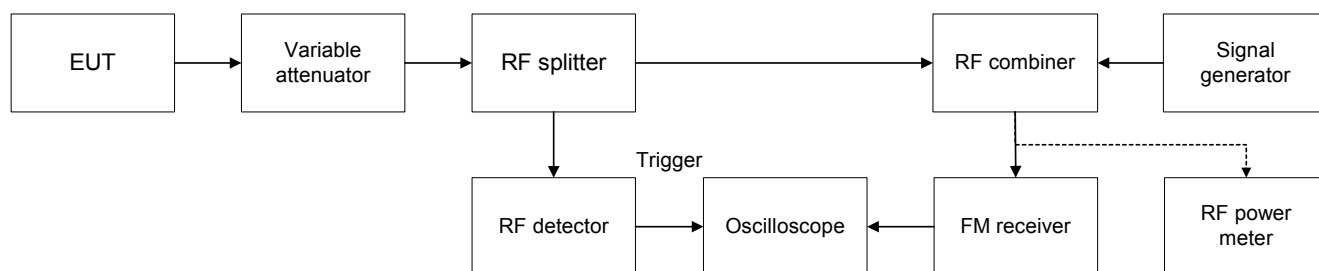
7.13.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

7.13.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

7.13.2.4 The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.

Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Figure 7.13.1 Transient frequency test setup





Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Table 7.13.2 Transient frequency behaviour test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 25 kHz						
450	t ₁	10	6	± 25.0	-19.0	Pass
	t ₂	25	0	± 12.5	-12.5	
	t ₃	10	0	± 25.0	-25.0	
460	t ₁	10	4	± 25.0	-21.0	Pass
	t ₂	25	0	± 12.5	-12.5	
	t ₃	10	0	± 25.0	-25.0	
470	t ₁	10	10	± 25.0	-15.0	Pass
	t ₂	25	4	± 12.5	-8.5	
	t ₃	10	0	± 25.0	-25.0	

Reference numbers of test equipment used

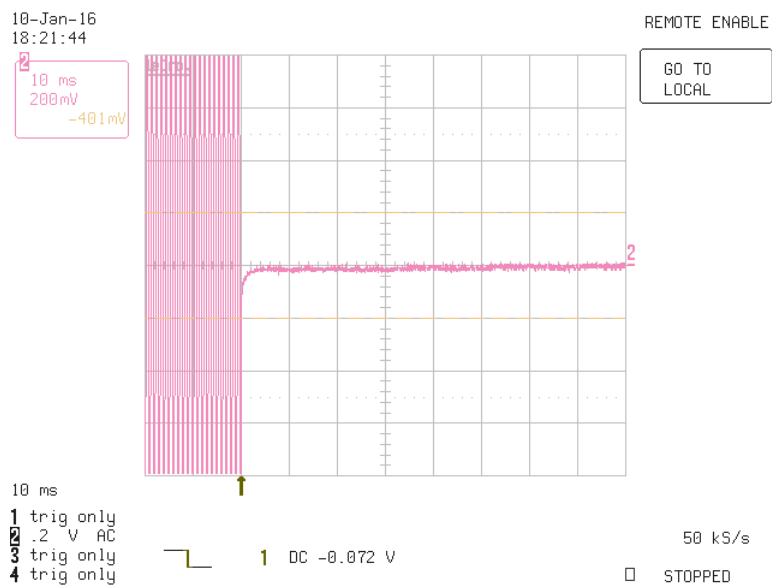
HL 0539	HL 0911	HL 2227	HL 3300	HL 3310	HL 3727	HL 4413	
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Full description is given in Appendix A.

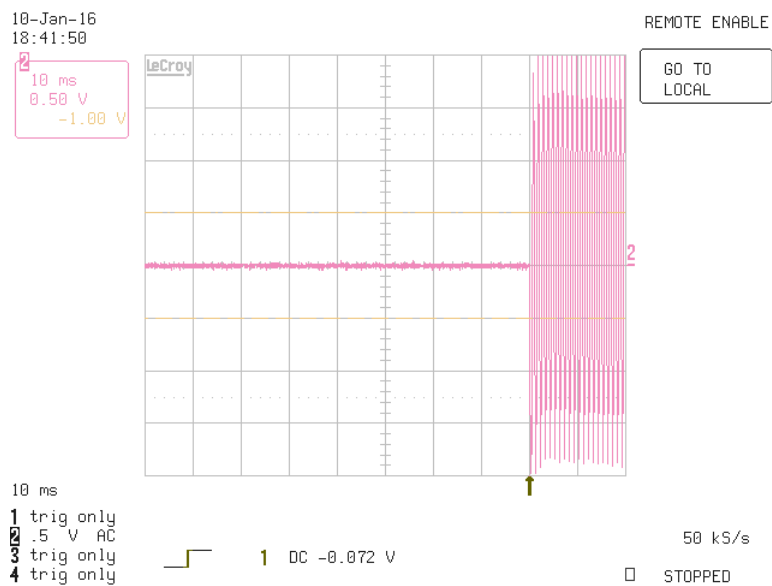
Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.13.1 Transient frequency during power ON test results at low carrier frequency

4 divisions vertically centered on the display= 50 kHz deviation of the FM modulation
1 div=12.5 kHz

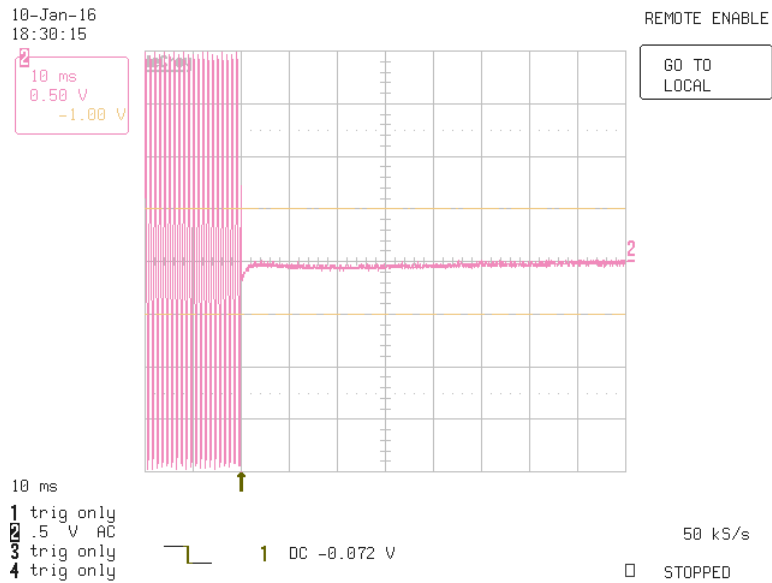


Plot 7.13.2 Transient frequency during power OFF test results at low carrier frequency

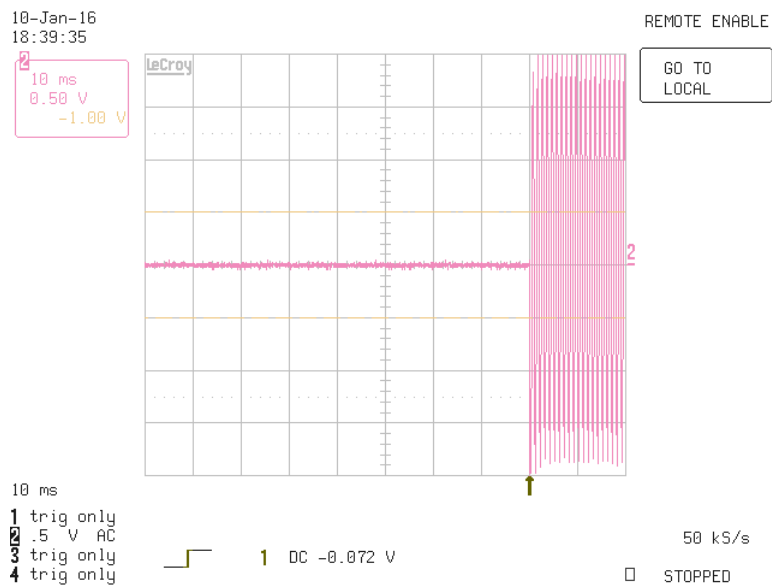


Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.13.3 Transient frequency during power ON test results at mid carrier frequency

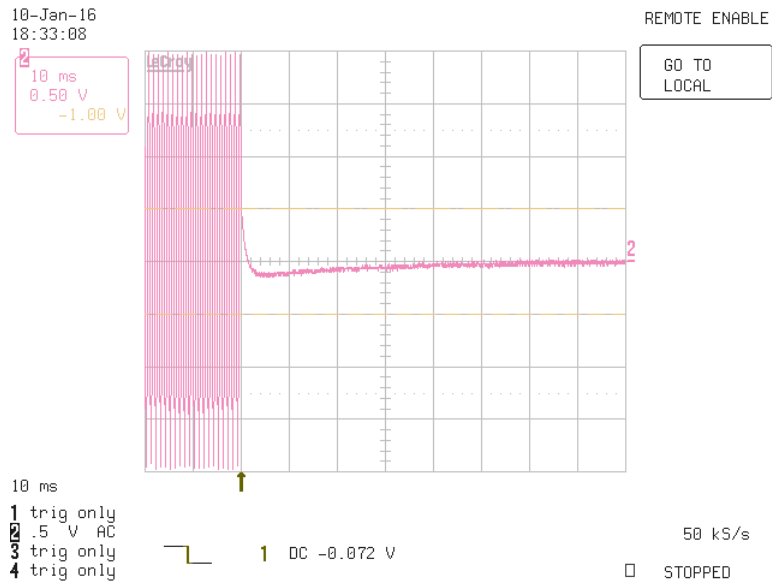


Plot 7.13.4 Transient frequency during power OFF test results at mid carrier frequency

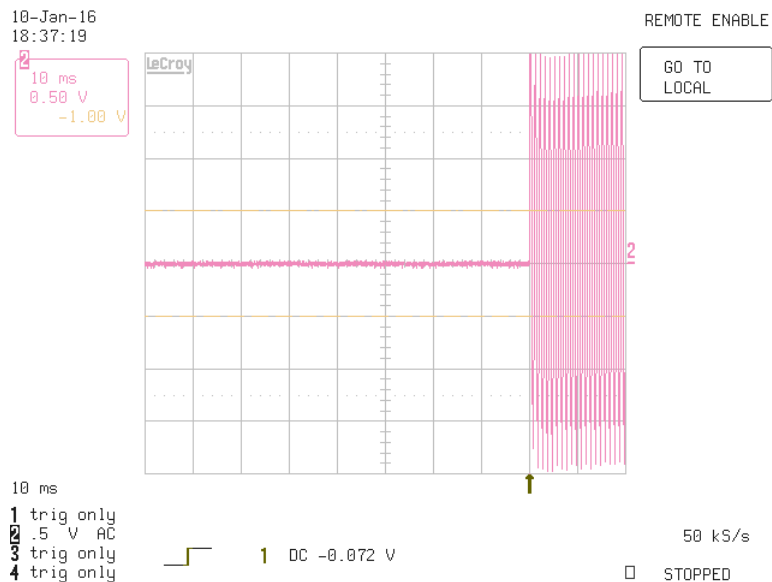


Test specification:		Section 90.214, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jan-16	
Temperature: 23 °C	Air Pressure: 1020 hPa	Relative Humidity: 56 %	Power Supply: Battery
Remarks: CBW 25 kHz			

Plot 7.13.5 Transient frequency during power ON test results at high carrier frequency



Plot 7.13.6 Transient frequency during power OFF test results at high carrier frequency



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	18-Jan-16	18-Jan-17
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	27-Oct-15	27-Oct-16
0539	Generator Signal, 10 kHz - 1.2 GHz	Marconi Instruments	2023	112121/04 1	31-Aug-15	31-Aug-16
0567	Antenna, Dipole, Tunable, 500 - 1000 MHz	Electro-Metrics	TDS-25/30-2	298	05-Feb-15	05-Feb-16
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	15-May-15	15-May-16
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	Hewlett Packard	83640B	3614A002 66	07-Apr-15	07-Apr-16
0911	Coupler Dual Directional, 20 dB, 0.1 - 2.0 GHz	Hewlett Packard	778D	1144A078 27	14-Feb-13	14-Feb-16
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies	8564EC	3946A002 19	12-Apr-15	12-Apr-16
1984	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz, 300 W	EMC Test Systems	3115	9911-5964	17-Apr-15	17-Apr-16
2227	Crystal Detector 0.01-18 GHz, 100 mW	Hewlett Packard Co	8472A	NA	27-Oct-15	27-Oct-17
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY451024 62	08-Sep-15	08-Sep-16
3210	Temperature Chamber, (-50...+100) °C	Associated Environmental Systems	NA	NA	09-Sep-15	09-Sep-16
3300	Attenuator set, 0 to 81 dB, 1 dB step, DC-18 GHz	Agilent Technologies	8494B/84 95B	MY421469 11/MY421 43939	16-Aug-15	16-Aug-16
3310	Multimeter	Fluke	115C	94321810	13-Jul-15	13-Jul-16
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	11-Mar-15	11-Mar-16
3435	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW-S10W5+	NA	10-Mar-15	10-Mar-16
3440	Precision Fixed Attenuator, 50 Ohm, 5 W, 20 dB, DC to 18 GHz	Mini-Circuits	BW-S20W5+	NA	01-Dec-15	01-Dec-16
3455	Medium Power Fixed Coaxial Attenuator DC to 40 GHz, 20 dB, 5 W	Aeroflex / Weinschel	75A-20-12	1182	11-Mar-15	11-Mar-16
3727	Oscilloscope, 1 GHz, 4 channels	LeCroy Corporation	LC584AL	10449	28-Jun-15	28-Jun-16
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	29-Apr-15	29-Apr-16
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLE X 102A	1226/2A	10-Feb-15	10-Feb-16
4068	Attenuator, SMA, 30 dB, DC to 12.4 GHz	Midwest Microwave	ATT-0527-30-SMA-07	NA	13-Jul-15	13-Jul-16
4114	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz	ETS Lindgren	3117	00123515	24-Dec-15	24-Dec-16
4275	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70050	22-Nov-15	22-Nov-16
4278	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0755A	22-Nov-15	22-Nov-16



HERMON LABORATORIES

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	15-Mar-15	15-Mar-16
4413	Resistive divider, DC to 1.5 GHz, 2 W	Microlab	DA-3FN	NA	15-Jul-14	15-Jul-16
4446	Coaxial Cable Ultraflex RF, 5.2 m, N type-N type, DC-5 GHz	Times Microwave Systems	LMR-500	NA	26-Aug-15	26-Aug-16
4932	Microwave preamplifier, 500 MHz to 18 GHz, 40 dB Gain	Com-Power Corporation	PAM-118A	551029	19-Nov-15	19-Nov-16

9 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	$\pm 8\%$
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz $\pm 13.9\%$
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0\%$
Unintentional radiator tests	
Radiated emissions at 3 m measuring distance	
Horizontal polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB
Vertical polarization	Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

10 APPENDIX C Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.

Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file number IC 2186A-1 for OATS), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is IL1001.

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Person for contact: Mr. Alex Usoskin, CEO.

11 APPENDIX D Specification references

47CFR part 90: 2014	Private land mobile radio services
47CFR part 1: 2015	Practice and procedure
47CFR part 2: 2015	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI/TIA/EIA-603-D:2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

12 APPENDIX E Test equipment correction factors

Antenna factor
Active loop antenna
Model 6502, S/N 2857, HL 0446

Frequency, MHz	Magnetic antenna factor, dB	Electric antenna factor, dB
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.8
0.750	-41.9	9.7
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.2
4.000	-41.4	10.1
5.000	-41.5	10.1
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field strength in dB(μ V/m).

Antenna factor
Biconilog antenna EMCO Model 3141
Ser.No.1011, HL 0604

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
26	7.8	580	20.6	1320	27.8
28	7.8	600	21.3	1340	28.3
30	7.8	620	21.5	1360	28.2
40	7.2	640	21.2	1380	27.9
60	7.1	660	21.4	1400	27.9
70	8.5	680	21.9	1420	27.9
80	9.4	700	22.2	1440	27.8
90	9.8	720	22.2	1460	27.8
100	9.7	740	22.1	1480	28.0
110	9.3	760	22.3	1500	28.5
120	8.8	780	22.6	1520	28.9
130	8.7	800	22.7	1540	29.6
140	9.2	820	22.9	1560	29.8
150	9.8	840	23.1	1580	29.6
160	10.2	860	23.4	1600	29.5
170	10.4	880	23.8	1620	29.3
180	10.4	900	24.1	1640	29.2
190	10.3	920	24.1	1660	29.4
200	10.6	940	24.0	1680	29.6
220	11.6	960	24.1	1700	29.8
240	12.4	980	24.5	1720	30.3
260	12.8	1000	24.9	1740	30.8
280	13.7	1020	25.0	1760	31.1
300	14.7	1040	25.2	1780	31.0
320	15.2	1060	25.4	1800	30.9
340	15.4	1080	25.6	1820	30.7
360	16.1	1100	25.7	1840	30.6
380	16.4	1120	26.0	1860	30.6
400	16.6	1140	26.4	1880	30.6
420	16.7	1160	27.0	1900	30.6
440	17.0	1180	27.0	1920	30.7
460	17.7	1200	26.7	1940	30.9
480	18.1	1220	26.5	1960	31.2
500	18.5	1240	26.5	1980	31.6
520	19.1	1260	26.5	2000	32.0
540	19.5	1280	26.6		
560	19.8	1300	27.0		

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field strength in dB(μ V/m).

Antenna factor
Double-ridged wave guide horn antenna
Model 3115, S/N 9911-5964, HL1984

Frequency, MHz	Antenna factor, dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.6
2500.0	28.9
3000.0	31.2
3500.0	32.0
4000.0	32.5
4500.0	32.7
5000.0	33.6
5500.0	35.1
6000.0	35.4
6500.0	34.9
7000.0	36.1
7500.0	37.8
8000.0	38.0
8500.0	38.1
9000.0	39.1
9500.0	38.3
10000.0	38.6
10500.0	38.2
11000.0	38.7
11500.0	39.5
12000.0	40.0
12500.0	40.4
13000.0	40.5
13500.0	41.1
14000.0	41.6
14500.0	41.7
15000.0	38.7
15500.0	38.2
16000.0	38.8
16500.0	40.5
17000.0	42.5
17500.0	45.9
18000.0	49.4

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field strength in dB(μ V/m).

Antenna factor
Double-ridged waveguide horn antenna
ETS Lindgren, Model 3117, serial number: 00123515, HL 4114

Frequency, MHz	Antenna factor, dB/m		
	Measured	Manufacturer	Deviation
1000	28.0	28.4	-0.4
1500	28.0	27.4	0.6
2000	31.2	30.9	0.3
2500	32.5	33.4	-0.9
3000	32.9	32.6	0.3
3500	32.7	32.8	-0.1
4000	33.1	33.4	-0.3
4500	33.8	33.9	-0.1
5000	33.8	34.1	-0.3
5500	34.4	34.5	-0.1
6000	35.0	35.2	-0.2
6500	35.4	35.5	-0.1
7000	35.7	35.7	0.0
7500	35.9	35.7	0.2
8000	35.8	35.8	0.0
8500	35.9	35.8	0.1
9000	36.3	36.2	0.1
9500	36.6	36.6	0.0
10000	37.1	37.1	0.0
10500	37.6	37.5	0.1
11000	37.9	37.7	0.2
11500	38.5	38.1	0.4
12000	39.2	38.7	0.5
12500	39.0	38.9	0.1
13000	39.1	39.1	0.0
13500	38.9	38.8	0.1
14000	39.0	38.8	0.2
14500	39.6	39.9	-0.3
15000	39.9	39.7	0.2
15500	39.9	40.1	-0.2
16000	40.7	40.8	-0.1
16500	41.3	41.8	-0.5
17000	42.5	42.1	0.4
17500	41.3	41.2	0.1
18000	41.4	40.9	0.5

Antenna factor is to be added to receiver meter reading in dB(μ V) to convert to field strength in dB(μ V/meter)



Cable loss
Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25679
Mini-Circuits, HL 3433

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	2.01
100	0.17	9500	2.06
500	0.41	10000	2.05
1000	0.58	10500	2.18
1500	0.72	11000	2.26
2000	0.86	11500	2.28
2500	0.96	12000	2.43
3000	1.04	12500	2.53
3500	1.13	13000	2.52
4000	1.23	13500	2.56
4500	1.31	14000	2.60
5000	1.41	14500	2.59
5500	1.49	15000	2.67
6000	1.55	15500	2.76
6500	1.63	16000	2.86
7000	1.71	16500	2.91
7500	1.78	17000	2.95
8000	1.86	17500	3.02
8500	1.92	18000	3.07

Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A
HL 3903

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	-0.02	9500	1.84	21000	2.98
100	0.15	10000	1.86	22000	3.07
500	0.38	10500	1.93	23000	3.13
1000	0.56	11000	1.99	24000	3.21
1500	0.69	11500	2.04	25000	3.26
2000	0.82	12000	2.10	26000	3.48
2500	0.90	12500	2.15	27000	3.44
3000	0.98	13000	2.21	28000	3.53
3500	1.06	13500	2.25	29000	3.59
4000	1.11	14000	2.29	30000	3.66
4500	1.17	14500	2.34	31000	3.70
5000	1.24	15000	2.36	32000	3.79
5500	1.32	15500	2.40	33000	3.88
6000	1.40	16000	2.45	34000	3.94
6500	1.50	16500	2.48	35000	3.91
7000	1.56	17000	2.56	36000	4.05
7500	1.62	17500	2.58	37000	4.22
8000	1.68	18000	2.60	38000	4.25
8500	1.74	19000	2.84	39000	4.27
9000	1.78	20000	2.88	40000	4.33

Cable loss
Test cable, Mini-Circuits, S/N 70050, 18 GHz, 1.8 m, SMA/M - N/M
CBL-6FT-SMNM+, HL 4275

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.08	5000	1.71	10200	2.64	15400	3.46
30	0.11	5100	1.73	10300	2.65	15500	3.47
50	0.14	5200	1.75	10400	2.66	15600	3.52
100	0.21	5300	1.76	10500	2.67	15700	3.55
200	0.30	5400	1.77	10600	2.70	15800	3.55
300	0.37	5500	1.82	10700	2.71	15900	3.55
400	0.43	5600	1.84	10800	2.72	16000	3.61
500	0.49	5700	1.86	10900	2.73	16100	3.62
600	0.54	5800	1.86	11000	2.75	16200	3.63
700	0.58	5900	1.89	11100	2.77	16300	3.62
800	0.62	6000	1.94	11200	2.78	16400	3.66
900	0.66	6100	1.95	11300	2.80	16500	3.71
1000	0.70	6200	1.96	11400	2.82	16600	3.71
1100	0.74	6300	1.97	11500	2.83	16700	3.67
1200	0.78	6400	2.01	11600	2.84	16800	3.69
1300	0.81	6500	2.03	11700	2.86	16900	3.74
1400	0.84	6600	2.02	11800	2.88	17000	3.73
1500	0.88	6700	2.02	11900	2.89	17100	3.71
1600	0.91	6800	2.05	12000	2.90	17200	3.73
1700	0.94	6900	2.06	12100	2.92	17300	3.77
1800	0.97	7000	2.07	12200	2.93	17400	3.77
1900	1.00	7100	2.07	12300	2.94	17500	3.76
2000	1.02	7200	2.08	12400	2.96	17600	3.76
2100	1.05	7300	2.11	12500	2.98	17700	3.78
2200	1.07	7400	2.13	12600	2.99	17800	3.80
2300	1.10	7500	2.15	12700	3.01	17900	3.79
2400	1.13	7600	2.16	12800	3.03	18000	3.78
2500	1.15	7700	2.18	12900	3.05		
2600	1.18	7800	2.21	13000	3.07		
2700	1.20	7900	2.24	13100	3.09		
2800	1.24	8000	2.25	13200	3.12		
2900	1.26	8100	2.26	13300	3.13		
3000	1.28	8200	2.29	13400	3.14		
3100	1.30	8300	2.31	13500	3.16		
3200	1.33	8400	2.33	13600	3.18		
3300	1.36	8500	2.33	13700	3.19		
3400	1.37	8600	2.34	13800	3.21		
3500	1.39	8700	2.36	13900	3.23		
3600	1.42	8800	2.38	14000	3.25		
3700	1.45	8900	2.39	14100	3.26		
3800	1.46	9000	2.40	14200	3.27		
3900	1.48	9100	2.42	14300	3.30		
4000	1.50	9200	2.45	14400	3.32		
4100	1.53	9300	2.46	14500	3.33		
4200	1.55	9400	2.48	14600	3.34		
4300	1.57	9500	2.50	14700	3.36		
4400	1.59	9600	2.52	14800	3.39		
4500	1.61	9700	2.54	14900	3.40		
4600	1.64	9800	2.56	15000	3.41		
4700	1.66	9900	2.58	15100	3.41		
4800	1.67	10000	2.60	15200	3.44		
4900	1.69	10100	2.61	15300	3.46		

Cable loss
Test cable, Mini-Circuits, S/N 0755A, 18 GHz, 4.6 m, N/M - N/M
APC-15FT-NMNM+, HL 4278

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.24	4900	4.19	10000	6.47	15100	8.33
30	0.26	5000	4.25	10100	6.50	15200	8.35
50	0.34	5100	4.29	10200	6.52	15300	8.37
100	0.50	5200	4.32	10300	6.57	15400	8.40
200	0.72	5300	4.38	10400	6.59	15500	8.42
300	0.90	5400	4.41	10500	6.61	15600	8.46
400	1.06	5500	4.46	10600	6.64	15700	8.50
500	1.20	5600	4.51	10700	6.64	15800	8.52
600	1.32	5700	4.56	10800	6.65	15900	8.56
700	1.44	5800	4.59	10900	6.68	16000	8.61
800	1.54	5900	4.64	11000	6.68	16100	8.64
900	1.64	6000	4.69	11100	6.69	16200	8.66
1000	1.74	6100	4.72	11200	6.70	16300	8.70
1100	1.83	6200	4.77	11300	6.74	16400	8.73
1200	1.92	6300	4.80	11400	6.78	16500	8.74
1300	2.01	6400	4.83	11500	6.81	16600	8.75
1400	2.09	6500	4.89	11600	6.84	16700	8.78
1500	2.18	6600	4.90	11700	6.87	16800	8.79
1600	2.25	6700	4.95	11800	6.92	16900	8.81
1700	2.33	6800	5.01	11900	6.98	17000	8.85
1800	2.39	6900	4.99	12000	7.02	17100	8.90
1900	2.47	7000	5.04	12100	7.08	17200	8.95
2000	2.53	7100	5.11	12200	7.15	17300	8.99
2100	2.60	7200	5.14	12300	7.20	17400	9.03
2200	2.67	7300	5.21	12400	7.26	17500	9.07
2300	2.73	7400	5.29	12500	7.31	17600	9.11
2400	2.80	7500	5.33	12600	7.36	17700	9.15
2500	2.87	7600	5.38	12700	7.41	17800	9.19
2600	2.93	7700	5.46	12800	7.46	17900	9.24
2700	3.00	7800	5.52	12900	7.51	18000	9.28
2800	3.06	7900	5.58	13000	7.55		
2900	3.12	8000	5.64	13100	7.59		
3000	3.18	8100	5.69	13200	7.65		
3100	3.24	8200	5.75	13300	7.69		
3200	3.30	8300	5.80	13400	7.72		
3300	3.35	8400	5.84	13500	7.78		
3400	3.42	8500	5.90	13600	7.82		
3500	3.46	8600	5.97	13700	7.86		
3600	3.52	8700	5.99	13800	7.91		
3700	3.57	8800	6.04	13900	7.96		
3800	3.61	8900	6.10	14000	8.01		
3900	3.67	9000	6.13	14100	8.06		
4000	3.71	9100	6.17	14200	8.10		
4100	3.77	9200	6.23	14300	8.13		
4200	3.83	9300	6.27	14400	8.16		
4300	3.89	9400	6.30	14500	8.19		
4400	3.94	9500	6.35	14600	8.21		
4500	4.00	9600	6.37	14700	8.23		
4600	4.05	9700	6.40	14800	8.26		
4700	4.10	9800	6.44	14900	8.28		
4800	4.16	9900	6.45	15000	8.30		

Cable loss
Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,
NC29-N1N1-244S/N 12025101 003,
HL 4353

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.20	9000	2.71
100	0.27	9500	2.81
300	0.47	10000	2.90
500	0.61	10500	2.97
1000	0.87	11000	3.06
1500	1.07	11500	3.13
2000	1.24	12000	3.20
2500	1.39	12500	3.26
3000	1.53	13000	3.34
3500	1.65	13500	3.39
4000	1.77	14000	3.47
4500	1.89	14500	3.54
5000	1.99	15000	3.62
5500	2.07	15500	3.69
6000	2.20	16000	3.76
6500	2.30	16500	3.83
7000	2.39	17000	3.86
7500	2.51	17500	3.94
8000	2.58	18000	4.02
8500	2.65		

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt

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